**UNITED STATES DEPARTMENT OF COMMERCE**
**National Oceanic and Atmospheric Administration**
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

March 31, 2005

Mr. William McDonald
Regional Director
U.S. Bureau of Reclamation
Pacific Northwest Region
1150 N. Curtis Rd., Suite 100
Boise, ID 83706-1234

Re: 2005 Biological Opinion for ESA Section 7 Consultation for the Operation and Maintenance of the USBR's Upper Snake River Basin Projects Above Brownlee Reservoir. NMFS Consultation No. 2004/01900.

Dear Mr. McDonald:

Enclosed is the 2005 Biological Opinion prepared by the National Marine Fisheries Service (NMFS) on the U.S. Bureau of Reclamation's (USBR) 12 proposed Federal actions in the Snake River Basin upstream from Brownlee Reservoir involving future operations and maintenance (O&M) for 12 Federal projects. This document represents NMFS' Biological Opinion (Opinion) of the effects of the proposed actions on listed species in accordance with Section 7(a)(2) of the Endangered Species Act of 1973 as amended (16 USC 1531 et seq.) (ESA). Specifically, this Opinion represents NMFS' response to USBR's:

- November 30, 2004, letter (and enclosed final biological assessment) requesting formal ESA Section 7(a)(2) consultation.
- February 16, 2005, letter providing additional information as requested by NMFS.
- March 23, 2005, letter with an amendment to the biological assessment to add a proposed action.

In this Opinion, NMFS determines that the proposed action is not likely to jeopardize the continued existence of listed Snake River (SR) spring/summer chinook salmon, SR fall chinook salmon, Upper Columbia River (UCR) spring-run chinook salmon, Upper Willamette River (UWR) chinook salmon, Lower Columbia River (LCR) chinook salmon, SR steelhead, UCR steelhead, Middle Columbia River (MCR) steelhead, UWR steelhead, LCR steelhead, Columbia River chum salmon, or SR sockeye salmon, or proposed LCR coho salmon; or result in the adverse modification or destruction of critical habitat for SR spring/summer-run chinook salmon, SR fall-run chinook salmon, and SR sockeye salmon.

Enclosed as Section 11 of this Opinion are the results of our consultation on the likely effects of the proposed actions on essential fish habitats (EFH) pursuant to Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267). NMFS finds that the proposed actions will adversely affect EFH for chinook and coho salmon and recommends that the USBR adopt the three terms and conditions of the incidental take statement (Section 10) of the Opinion as EFH conservation recommendations to avoid, minimize, or otherwise offset potential adverse effects to EFH.

Section 305(b)(4)(B) of the MSA requires Federal agencies to provide a detailed written response to NMFS within 30 days after receiving these recommendations. If the response is inconsistent with the recommendations, the USBR must explain why the recommendations will not be followed, including any justification for any disagreements over the effects of the action and the recommendations. In response to increased oversight of overall EFH program effectiveness by the White House Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, in your statutory reply to the EFH portion of this consultation, we ask that you clearly identify the number of conservation recommendations accepted.

NMFS recently completed its status review of 27 Pacific salmon and steelhead species listed and proposed for listing under the ESA and expects its final determinations to be published in the Federal Register by August 2005. For several species considered in this consultation, the Opinion does not reflect the changes in the status that have been proposed.

Sincerely,

D. Robert Lohn

D. Robert Lohn
Regional Administrator

cc: Jerrold D. Gregg
Lesa Stark

**Endangered Species Act**
**Section 7(a)(2) Consultation**

# Biological Opinion
# and
# Magnuson-Stevens Fishery Conservation and Management Act Consultation

## Consultation for the Operation and Maintenance of 12 U.S. Bureau of ReclamationProjects in the Upper Snake River Basin above Brownlee Reservoir

| | |
|---|---|
| Action Agency: | U.S. Bureau of Reclamation |
| Consultation Conducted by: | National Marine Fisheries Service<br>Northwest Region |
| NMFS Log Number: | F/NWR/2004/01900 |
| Date: | March 31, 2005 |

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## 1.1 Introduction

The Endangered Species Act (ESA) (16 USC 1531-1544) established a national program for the conservation of threatened and endangered species of fish, wildlife, plants, and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS), and, as appropriate, to ensure that their actions are not likely to jeopardize the continued existence of species listed as endangered or threatened, or to adversely modify or destroy their designated critical habitat. This is a biological opinion (Opinion) on the likely effects of 12 proposed actions (Table 1-1) involving 12 Federal irrigation projects and numerous facilities (Tables 1-2, 1-3, and 1-4) located in the Snake River Basin upstream from Brownlee Reservoir, Idaho (Figure 1-1) on ESA-listed salmon and steelhead.[1] It is the product of an interagency consultation pursuant to Section 7(a)(2) of the ESA and implementing regulations (50 CFR 402).

The construction and operation of the U.S. Bureau of Reclamation's (USBR's) Upper Snake Basin projects are Congressionally authorized to serve specific project purposes by the 1902 Reclamation Act and numerous other acts. The primary purpose for each of the projects is to provide water for irrigated agriculture. Although each of the 12 USBR proposed actions (hereinafter referred to as the proposed action, or PA) is wholly independent of each other, and could each be the subject of a separate ESA Section 7(a)(2) consultation, USBR and NMFS have chosen to encompass all of them within this one formal consultation, consistent with its regulations at 50 CFR 402.14(c). The projects considered in this Opinion, however, are operated wholly independently from the Federal Columbia River Power System (FCRPS), which is not included as a proposed action for this consultation.[2] Moreover, since salmon and steelhead passage is blocked currently by the Idaho Power Company's Hells Canyon Complex, listed salmon or steelhead are not present in locations where USBR project operations take place. This consultation is on the effects of the USBR's proposed project operations, as defined in its proposed action, on listed salmon and steelhead in currently occupied mainstem Snake and Columbia River habitats downstream from Hells Canyon Dam.

The analysis herein also fulfills the Essential Fish Habitat (EFH) requirements under the Magnuson-Stevens Fishery Conservation and Management Act (MSA). The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures to identify, conserve, and enhance EFH for those species regulated under a Federal fisheries

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[1]For the reasons discussed in Section 3, this Opinion considers the effects of all 12 proposed actions identified in Table 1-1 in aggregate only and does not find it necessary to delineate the effects of the individual proposed actions to fully evaluate the significance of those effects on ESA-listed anadromous fish.

[2]Several USBR storage facilities in the Upper Snake Basin are classified as Category II flood control reservoirs (Jackson Lake, Palisades, Anderson Ranch, Arrowrock, Lucky Peak, Cascade, and Deadwood) in the Columbia River Treaty Flood Control Operating Plan (USACE 1999). These reservoirs were authorized for local flood control and provide incidental system flood control benefits (system flood control protects the Portland, Oregon–Vancouver, Washington metropolitan area) through storage made available for other reasons (e.g., irrigation drawdowns, local flood control drawdowns). In some years, system flood control benefits may be provided through informal arrangements calling for delayed refilling.

management plan. Federal agencies must consult with NMFS on all actions or proposed actions (authorized, funded, or undertaken) that may adversely affect EFH (Section 305(b)(2)).

**Table 1-1**. USBR proposed actions considered in this Opinion.

| |
|---|
| - Future O&M in the Snake River system above Milner Dam (Michaud Flats, Minidoka, Palisades, and Ririe Projects). |
| - Future operations in the Little Wood River system (Little Wood River Project). |
| - Future O&M in the Owyhee River system (Owyhee Project). |
| - Future O&M in the Boise River system (Arrowrock Division of the Boise Project and the Lucky Peak Project [irrigation operations only]). |
| - Future O&M in the Payette River system (Payette Division of the Boise Project). |
| - Future O&M in the Malheur River system (Vale Project). |
| - Future O&M in the Mann Creek system (Mann Creek Project). |
| - Future O&M in the Burnt River system (Burnt River Project). |
| - Future O&M in the upper Powder River system (Upper Division of the Baker Project). |
| - Future O&M in the lower Powder River system (Lower Division of the Baker Project). |
| - Future provision of salmon flow augmentation from the rental or acquisition of natural flow rights. |
| - Surveys and studies for Snake River physa in the Snake River reach below Minidoka Dam. |

**Figure 1-1.** USBR projects in the Upper Snake River Basin.

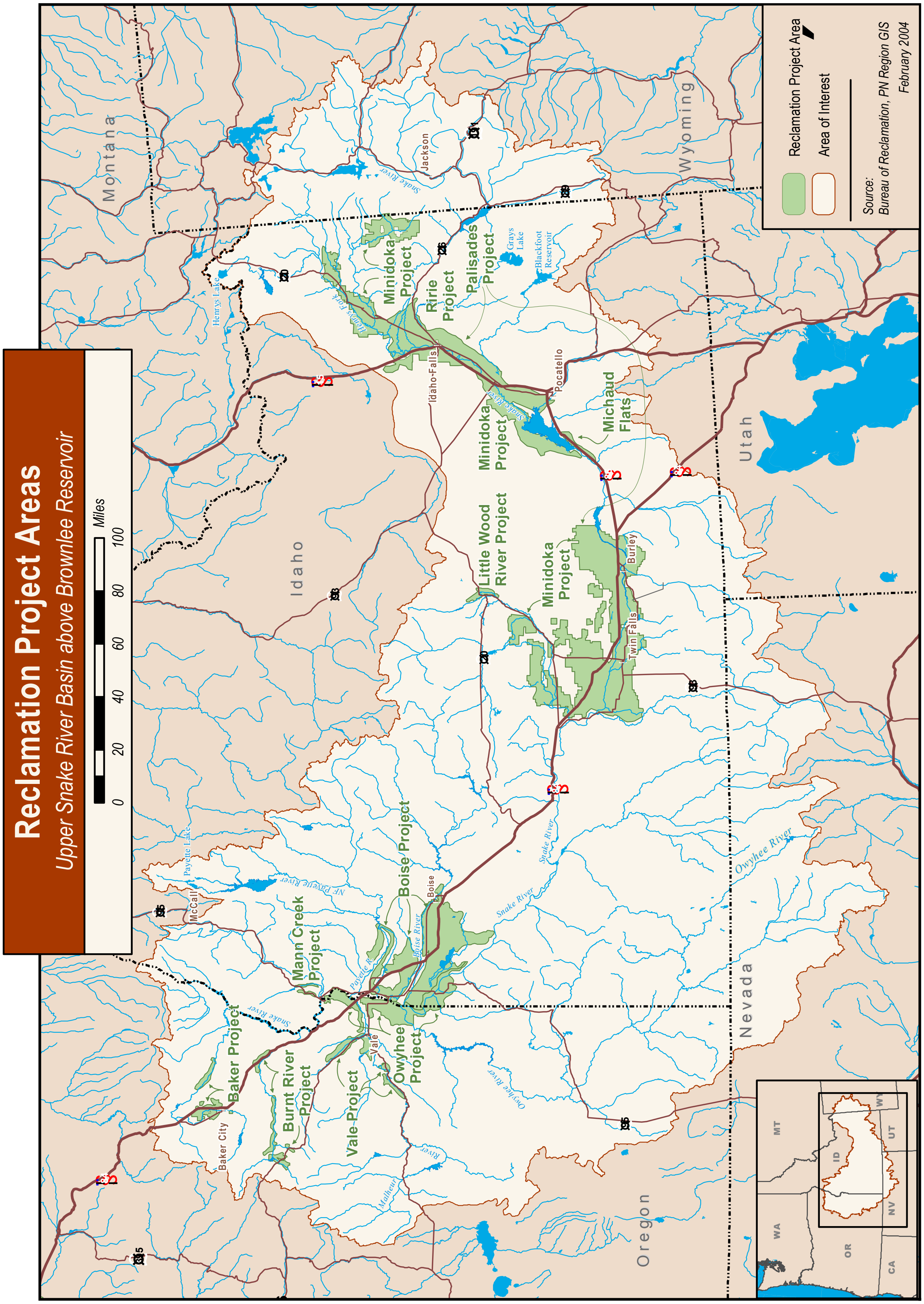

**Table 1-2**. Federal water storage facilities in the Snake River Basin upstream from Brownlee Reservoir included in the proposed action.

| Storage Facility[1] | Stream and River Mile | Active Capacity[2] (acre-feet) | Powerplant Owner | Operating and Maintaining Entity |
|---|---|---|---|---|
| **Minidoka Project** | | | | |
| Jackson Lake Dam | Snake River 988.9 | 847,000 | No powerplant | Reclamation |
| Grassy Lake Dam | Grassy Creek 0.5 | 15,200 | No powerplant | Fremont-Madison Irrigation District |
| Island Park Dam | Henry Fork 91.7 | 135,205 | Non-Federal | Fremont-Madison Irrigation District |
| American Falls Dam | Snake River 714.0 | 1,672,590 | Non-Federal | Reclamation |
| Minidoka Dam | Snake River 674.5 | 95,200 | Reclamation | Reclamation |
| **Palisades Project** | | | | |
| Palisades Dam | Snake River 901.6 | 1,200,000 | Reclamation | Reclamation |
| **Ririe Project** | | | | |
| Ririe Dam | Willow Creek 20.5 | 80,541 | No powerplant | Reclamation |
| **Little Wood River Project** | | | | |
| Little Wood River Dam [3] | Little Wood River 78.8 | 30,000 | Non-Federal | Little Wood River Irrigation District |
| **Owyhee Project** | | | | |
| Owyhee Dam | Owyhee River 28.5 | 715,000 | Non-Federal | Owyhee Irrigation District |
| **Boise Project** | | | | |
| Anderson Ranch Dam | S.F. Boise River 43.5 | 413,074 | Reclamation | Reclamation |
| Arrowrock Dam | Boise River 75.4 | 272,224 | No powerplant | Reclamation |
| Hubbard Dam | New York Canal | 1,177 | No powerplant | Boise Project Board of Control |
| Deer Flat Dams | New York Canal | 159,365 | No powerplant | Boise Project Board of Control |
| Deadwood Dam | Deadwood River 18.0 | 153,992 | No powerplant | Reclamation |
| Cascade Dam | N.F. Payette River 38.6 | 646,461 | Non-Federal | Reclamation |
| **Lucky Peak Project** | | | | |
| Lucky Peak Dam [4] | Boise River 64.0 | 264,371 | Non-Federal | Army Corps of Engineers |
| **Vale Project** | | | | |
| Warm Springs Dam [5] | Malheur River 114.0 | 169,714 | No powerplant | Warm Springs Irrigation District |
| Agency Valley Dam | N.F. Malheur River 15.0 | 59,212 | No powerplant | Vale Oregon Irrigation District |
| Bully Creek Dam | Bully Creek 12.5 | 23,676 | No powerplant | Vale Oregon Irrigation District |
| **Mann Creek Project** | | | | |
| Mann Creek Dam | Mann Creek 13.2 | 10,900 | No powerplant | Mann Creek Irrigation District |
| **Burnt River Project** | | | | |
| Unity Dam | Burnt River 63.6 | 24,970 | No powerplant | Burnt River Irrigation District |
| **Baker Project** | | | | |
| Mason Dam | Powder River 122.0 | 90,540 | No powerplant | Baker Valley Irrigation District |
| Thief Valley Dam | Powder River 70.0 | 13,307 | No powerplant | Lower Powder River Irrigation District |

[1]USBR owns all facilities unless otherwise indicated.
[2]Active capacity is the volume of storage space that can be filled and released for specific purposes.
[3]The Little Wood River Irrigation District owns the Little Wood River Dam.
[4]The Army Corps of Engineers owns Lucky Peak Dam; Reclamation administers water service and repayment contracts for irrigation.
[5]Reclamation has a one-half interest in Warm Springs Reservoir and associated storage.

**Table 1-3**. Federal diversion facilities included in the proposed actions.

| Diversion Facility | Stream | Owner | Operating and Maintaining Entity |
|---|---|---|---|
| **Minidoka Project** | | | |
| Cascade Creek Diversion Dam | Cascade Creek | United States | Fremont-Madison Irrigation District |
| Minidoka Northside Headworks | Snake River | United States | Minidoka Irrigation District |
| Minidoka Southside Headworks | Snake River | United States | Burley Irrigation District |
| Unit A Pumping Plant | Snake River | United States | A & B Irrigation District |
| Milner-Gooding Canal Headworks | Snake River | United States | American Falls Reservoir District No. 2 |
| **Michaud Flats Project** | | | |
| Falls Irrigation Pumping Plant | Snake River | United States | Falls Irrigation District |
| **Owyhee Project** | | | |
| Tunnel No. 1 | Owyhee River | United States | Owyhee Irrigation District |
| Dead Ox Pumping Plant | Snake River | United States | Owyhee Irrigation District |
| Ontario-Nyssa Pumping Plant | Snake River | United States | Ontario-Nyssa and Owyhee Irrigation Districts |
| Gem Pumping Plants #1 and #2 | Snake River | United States | Gem Irrigation District |
| **Boise Project** | | | |
| Boise River Diversion Dam | Boise River | United States | Boise Project Board of Control [1] |
| Black Canyon Diversion Dam | Payette River | United States | Reclamation |
| **Vale Project** | | | |
| Harper Diversion Dam | Malheur River | United States | Vale Oregon Irrigation District |
| Bully Creek Diversion Dam | Bully Creek | United States | Vale Oregon Irrigation District |
| **Mann Creek Project** | | | |
| Mann Creek Dam Outlet | Mann Creek | United States | Mann Creek Irrigation District |
| **Baker Project** | | | |
| Savely Dam and Lilley Pumping Plant | Powder River | United States | Lower Powder River Irrigation District |
| 1 The Boise Project Board of Control operates and maintains the dam. Reclamation operates and maintains the powerplant. | | | |

**Table 1-4**. Federal powerplants included in the proposed action.

| Powerplant | Stream | Impoundment | Nameplate Rating |
|---|---|---|---|
| Palisades Powerplant | Snake River | Palisades Dam | 176,600 kW |
| Inman and Minidoka Powerplants | Snake River | Minidoka Dam | 28,500 kW |
| Anderson Ranch Powerplant | South Fork Boise River | Anderson Ranch Dam | 40,000 kW |
| Boise River Diversion Powerplant | Boise River | Boise River Diversion Dam | 1,500 kW |
| Black Canyon Powerplant | Payette River | Black Canyon Diversion Dam | 8,000 kW |

## 1.2 Application of ESA Section 7(a)(2) Standards – Jeopardy Analysis Framework

This section reviews the approach used in this Opinion to apply the standards for determining the likelihood of jeopardy to listed species and adverse modification of critical habitat as set forth in Section 7(a)(2) of the ESA and as defined in 50 CFR 402 (the consultation regulations).[3]

In conducting analyses of actions under Section 7 of the ESA, NMFS takes the following steps, as directed by the consultation regulations:

1. Evaluates the current status of the species at the Evolutionarily Significant Unit (ESU) level with respect to biological requirements indicative of survival and recovery, and the essential physical and biological features of any designated critical habitat.

2. Evaluates the relevance of the environmental baseline in the action area to biological requirements and the species' current status, as well as the status of any designated critical habitat.

3. Determines whether the proposed action reduces the abundance, productivity, or distribution of the species, or alters any physical or biological features of designated critical habitat.

4. Determines and evaluates any cumulative effects within the action area.

5. Evaluates whether the effects of the proposed action, taken together with any cumulative effects and added to the environmental baseline, can be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the affected species, or is likely to destroy or adversely modify their designated critical habitat (see CFR §402.14(g).

If, in completing step 5, NMFS determines that the action under consultation is likely to jeopardize the continued existence of ESA-listed species or adversely modify designated critical habitat, NMFS must identify a reasonable and prudent alternative (RPA) for the action that is not likely to jeopardize the continued existence of ESA-listed species or adversely modify their designated critical habitat and meets the other regulatory requirements for an RPA (see 50 CFR §402.02).

### 1.2.1 Step 1: Evaluate Current Status with Respect to Range-wide Biological Requirements and Essential Features of Critical Habitat

NMFS applies ESA Section 7(a)(2) to the listed ESUs of salmon and steelhead by first defining the species' range-wide biological requirements and evaluating their status relative to those

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[3]Application of the definition in these regulations of "destruction or adverse modification" (50 CFR §402.02) is under further consideration in light of a recent court decision in this Circuit, *Gifford Pinchot Task Force v. USFWS*, No. 03-35279 (9th Cir. August 6, 2004). For the purposes of this opinion, NMFS did not rely on this regulatory definition. Instead NMFS relied upon the statutory provisions of the ESA to complete its analysis with respect to critical habitat.

requirements. The risk currently faced by each ESU informs NMFS' determination of whether a reduction in the productivity, abundance, or distribution of the species would reasonably be expected to "appreciably reduce" the likelihood of both survival and recovery in the wild (in Step 5). The greater the current risk, the more likely that any additional risk resulting from the proposed action's effects on productivity, abundance, or distribution of the listed species will constitute an "appreciable reduction in the likelihood of both survival and recovery." Similarly, when considering whether the proposed action is likely to result in an "adverse modification" of critical habitat, the status of the ESU is also relevant.

For this Opinion, NMFS reviewed the current status of the populations affected by the proposed action in the context of viable salmonid population (VSP) criteria,[4] and then reviewed the status of each major population group before reaching a conclusion for an ESU. NMFS based this analysis on information published in its June 14, 2004, Status Review (69 FR 33102), which states the reason for proposing to continue the listing of each ESU and any other relevant information about its status that constitutes the best scientific information available. In many cases, the status of an ESU was informed by the condition of habitat necessary to meet the species' biological requirements. Habitat attributes important to the species can be described in terms of physical, chemical, and biological parameters affected by the action under consultation (Habitat Approach, NMFS 1999).

In Step 1, NMFS also reviewed the essential features of designated critical habitat, as described in the critical habitat designations. Critical habitat is currently designated for three Snake River (SR) salmon ESUs: SR spring/summer chinook salmon, SR fall chinook salmon, and SR sockeye salmon (see Section 2.1.4 for the status of critical habitat designations for eight other Columbia Basin ESUs).[5] The designations for these ESUs identify the following component areas: juvenile rearing areas, juvenile migration corridors, areas for growth and development to adulthood, adult migration corridors, and spawning areas. During these life-history stages, the fish obtain their biological requirements through access to essential features of critical habitat areas. Their biological requirements include adequate water quantity; water velocity; cover or shelter; food, air, light, minerals, or other nutritional or physiological requirements; riparian vegetation; substrate; space for population growth and normal behavior; safe passage conditions;

[4]Pursuant to NMFS' current recovery planning, an ESU will have achieved conditions needed for its long-term survival and recovery when a sufficient number and distribution of populations in the ESU are "viable." Viable populations are those that are large enough to safeguard the genetic diversity of the listed ESUs, enhance their capacity to adapt to various environmental conditions, and enable them to become self-sustaining in the natural environment. McElhany et al. (2000) describes viable "salmonid populations" (VSP) as having a negligible risk of extinction due to threats from demographic variation (random or directional), local environmental variation, and genetic diversity changes (random or directional) over a 100-year time frame. The attributes associated with VSPs include adequate abundance, productivity, spatial structure, and diversity. These attributes are influenced by survival, behavior, and experiences throughout the entire life cycle, and these, in turn, are influenced by habitat and other environmental conditions. NMFS established Technical Recovery Teams (TRT) to describe the component populations in each ESU, viability criteria for each of those populations, and the number and distribution of populations that must be viable for an ESU to attain recovery.

[5]The geographic extent of critical habitat designated for each of these species is described in Appendix A.

and water quality.[6] These essential features of the currently designated critical habitat generally correspond to the habitat attributes that are associated with the biological requirements of all the listed species.

NMFS further evaluates whether the effects of the action cause alterations modifying any physical or biological features that were the basis for determining the habitat to be critical.

### 1.2.2 Step 2: Evaluate Relevance of the Environmental Baseline in the Action Area to Biological Requirements and the Current Status of the Species and Any Designated Critical Habitat

In this step, NMFS analyzes the effects of past, present, and certain future human factors within the action area to which the effects of the proposed action would be added. The environmental baseline, together with cumulative effects (Step 4), provides the starting point for evaluating whether the action would cause, directly or indirectly, a reduction in the productivity, abundance, or distribution of the listed species. Also, Steps 1 and 2 collectively inform NMFS' determination of whether reductions in abundance, productivity, or distribution associated with effects of the proposed action would "appreciably reduce" the likelihood of both survival and recovery. The worse the status of the ESU and the greater the current risk to the species within the action area under the environmental baseline, the more likely that additional adverse effects within the action area will appreciably reduce the likelihood of the ESU's survival and recovery.

The environmental baseline includes "the past and present impacts of all Federal, State, or private actions and other human activities in the action area, including the anticipated impacts of all proposed Federal projects in the action area that have undergone Section 7 consultation and the impacts of State and private actions that are contemporaneous with the consultation in progress" (50 CFR 402.02). For this Opinion, NMFS' consideration of these impacts is found in Section 5.

The following steps are those that NMFS takes to evaluate the relevance of the environmental baseline to biological requirements and the species' current status.

#### 1.2.2.1 Define the Action Area

The action area defines the geographic scope of the environmental baseline and cumulative effects that are relevant to a particular consultation. It includes all areas affected directly or indirectly by the Federal action, not merely the immediate area involved in the action (50 CFR 402.02). The action area is not delineated by the migratory range of the species affected by the project. Thus the action area would not include areas to which affected fish migrate but which are otherwise unaffected by the action. NMFS defines the action area for this Opinion in Section 5.

[6]Specifically, the water quality parameters of interest in the mainstem portion of the action area for this consultation are total dissolved gas (TDG) and temperature.

#### 1.2.2.2 Determine Biological Requirements and Essential Habitat Features within the Action Area

Biological requirements can be expressed as those habitat conditions or survival rates within the action area that support a sufficient number and distribution of viable populations (i.e., populations with adequate abundance, productivity, spatial structure, and diversity) necessary for the survival and recovery of the ESU. When sufficient quantitative information exists, the best available scientific information indicates that these biological requirements can be estimated as the survival rates associated with properly functioning habitat conditions.

Alternatively, where survival rates cannot be measured, the biological requirements can be discerned from conditions described in the scientific literature as fully functioning and sufficient to support salmonid survival and recovery.

Range-wide, the biological requirements of an ESU needed for its long-term survival and recovery are a sufficient number and distribution of viable populations, regardless of whether the proposed action is implemented. The factors that directly influence the viability of a population, and thus are relevant for NMFS' assessment of its status within the action area, are the habitat conditions and survival rates associated with a properly functioning salmonid habitat. For critical habitat, they are the designated essential physical and biological features. For this Opinion, the definition of these biological requirements is in Section 5.

#### 1.2.2.3 Evaluate the Environmental Baseline Relative to the Biological Requirements and Species Status

The purpose of this step in the analysis is to assess the present and future baseline conditions in the action area that would affect the listed species and critical habitat, without assuming the implementation of the proposed action. The present and future effects of the proposed action are eventually evaluated in the context of the action area environmental baseline.

Where the proposed action is a continuation of a past action, as is the case for the operation of USBR's Upper Snake River Basin projects, the analysis for this step is complicated, because the environmental baseline will necessarily include the effects of past actions taken to construct and operate the ongoing projects. NMFS must therefore distinguish the effects of the proposed future operation of the projects from their past construction and operation. As described in more detail in Section 5, NMFS made this distinction by following the fundamental principle of an ESA Section 7(a)(2) consultation. Section 402.03 provides, "Section 7 and the requirements of this part apply to all actions in which there is discretionary involvement or control." Accordingly, the ESA requires a Federal agency to consult on actions that it proposes to authorize, fund, or carry out that are within its discretionary authority (see also 50 CFR 402.02 "action" and ESA Section 7(a)(2)). Conversely, the effects of the existing project that are beyond the current discretion of the action agency are properly part of the effects of the environmental baseline. Those effects are part of the "no action" environment to which will be added the effects of the proposed action.

Once NMFS determines the effects of the environmental baseline, including the past effects of USBR's Upper Snake River Basin projects, it evaluates the significance of those effects in relation to the action-area biological requirements for the 13 ESUs[7] considered in this Opinion. NMFS evaluated reach survival through the Hells Canyon reach of the Snake River and the mainstem hydro corridor (i.e., over sections or the entire reach between the upper end of Lower Granite Pool and the area immediately below Bonneville Dam). These reach survival estimates were developed using the tool of a "reference operation" (described in Section 5) and were assumed to integrate the effects of habitat condition on fish survival and condition. To determine the relevance of the environmental baseline to the biological requirements of each ESU, NMFS compared the estimates of reach survival under the environmental baseline to estimates of reach survival associated with properly functioning habitat conditions in the mainstem reach. Where such survival rates could not be measured, NMFS compared habitat condition in the environmental baseline to the conditions described in the scientific literature as fully functioning and sufficient to support salmonid survival and recovery.

The current status of the species and its critical habitat in the action area is indicated by the extent to which conditions under the environmental baseline fall short of the species' biological requirements. The species' status in the action area is important for the determinations in Step 5, because it is more likely that any additional adverse effects caused by the proposed action will be significant if the species' status is poor and the baseline is already considerably degraded at the time of the consultation. Similarly, the status of habitat in the action area is a factor for determining whether an additional alteration of an essential feature of critical habitat would appreciably diminish the value of that critical habitat.

### 1.2.3 Step 3: Describe the Effects of the Proposed Action

The effects of the action, to be evaluated in Step 3, are defined as "the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with the action, that will be added to the environmental baseline" (50 CFR 402.02). Direct effects occur at a project site and may extend upstream or downstream. Indirect effects are defined in 50 CFR 402.02 as "those that are caused by the proposed action and are later in time, but still are reasonably certain to occur." They include the effects on listed species of future activities that are induced by the proposed action and that occur after the action is completed. "Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration" (50 CFR 402.02).

For the current consultation, this step involved identification and consideration of the adverse effects of the proposed operations of USBR's Upper Snake River Basin projects on the listed species and the essential features of their designated critical habitat. The proposed action also includes improvements of the ongoing flow augmentation program to reduce mortality as fish traverse the Snake/Columbia migratory corridor.

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[7]Pursuant to Section 7(a)(4) of the ESA, USBR has requested that NMFS conference on the effects of its proposed project operations on Lower Columbia River coho salmon, proposed for listing on June 14, 2004.

To determine whether the action causes an alteration of an essential habitat feature that is likely to result in the destruction or adverse modification of designated critical habitat, NMFS is using two alternative methods in the absence of a regulatory definition of this standard (see Footnote 3). The first method, the Environmental Baseline Approach, uses as a point of reference the environmental baseline to which the effects of the action will be added, as that term is defined by the "effects of the action" definition in the consultation regulations. If NMFS determines that the proposed action is likely to alter an essential feature of critical habitat compared to the condition under the environmental baseline, it will then consider whether that alteration appreciably diminishes the value of critical habitat for survival or recovery. As with the jeopardy determination, this determination will be influenced by the status of the ESU and the degree to which existing environmental baseline conditions of the affected essential features meet the biological requirements of the species for survival or recovery.

As an alternative to this analysis of the Section 7(a)(2) critical habitat standard, NMFS will use the Listing Conditions Approach. To determine if the proposed action adversely alters an essential feature of critical habitat, NMFS will alternatively refer to the condition of the essential feature (also known as a "primary constituent element," or PCE) as it existed at the time the species was listed.[8] The essential feature will have been altered if the action reduces its function below that which existed at the time of listing. As with the first alternative, if there is an alteration of an essential feature of critical habitat compared to this reference point, then NMFS will consider whether the alteration appreciably diminishes the value of critical habitat for survival or recovery. This determination will be influenced by the status of the ESU and the degree to which reference conditions for the affected essential feature at the time of listing met the biological requirements of the species for survival or recovery.

### 1.2.4 Step 4: Describe Cumulative Effects

Step 4 requires NMFS to evaluate the future beneficial or harmful effects of those State or private activities (not including Federal activities) that are reasonably certain to occur in the action area.[9] Indicators that actions are reasonably certain to occur may include, but are not limited to, approval of the action by State, tribal, or local agencies or governments (e.g., permits, grants); indications by State, tribal, or local agencies or governments that granting authority for the action is imminent; a project sponsor's assurance that the action will proceed; obligation of venture capital; or initiation of contracts (USFWS and NMFS 1998). At the same time, "reasonably certain to occur" does not require a guarantee that the action will occur. However, the more State, tribal, or local administrative discretion that remains to be exercised before a non-Federal action can proceed, the less NMFS can be reasonably certain that the project will be

[8]Critical habitat is statutorily defined to include "the specific areas within the geographic area occupied by the species, at the time it is listed. . .on which *are found* those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection." Since the physical or biological features that comprise the critical habitat were presumably present at the time of listing, the condition of the habitat at the time of listing can be used as a benchmark to determine whether the proposed action is likely to adversely modify those previously present features.

[9]The past and present effects of non-Federal actions are part of the environmental baseline. The future effects of future Federal activities are part of the environmental baseline, provided they have undergone ESA Section 7 consultation.

authorized. Similarly, the more economic, administrative, and legal hurdles that remain to be cleared, the less NMFS can be reasonably certain the project will proceed. For this Opinion, non-Federal actions that could not meet these standards were not included in the "cumulative effects" analysis.

NMFS assessed whether the net impact of any cumulative effect would be to improve or degrade the baseline, and estimated, to the extent practical, the magnitude of any change. If the status of the environmental baseline was very poor, but a suite of "reasonably certain to occur" actions was identified from which beneficial cumulative effects were likely, NMFS tolerated a greater adverse effect from the proposed action before adjudging it an "appreciable reduction." By the same token, expected harmful cumulative effects from "reasonably certain to occur" actions reduced the tolerance level.

### 1.2.5 Step 5: Conclusion

NMFS determines whether it is reasonable to expect that the net effects of the action, when added to the effects of the "environmental baseline," and "cumulative effects" in the action area, would, directly or indirectly, appreciably reduce the likelihood of both the survival and recovery of the listed species or result in the destruction or adverse modification of designated critical habitat (50 CFR 402.14(g)). As described above, the biological requirements and current status are the relevant factors indicative of the likelihood of survival and recovery.

If, in Step 3, NMFS determines that the proposed action would either not affect or would result in a net improvement in survival or habitat condition for a given ESU, NMFS would conclude that the action is not likely to jeopardize that ESU or adversely modify critical habitat. Because there would be no net reduction in the productivity, abundance, or distribution of the ESU, there could not be an appreciable reduction in the likelihood of both survival and recovery in accordance with the regulatory definition of "jeopardize the continued existence of" (50 CFR 402.02).

If NMFS determines in Step 3 that the proposed action would reduce the abundance, productivity, or distribution of a given ESU compared to the environmental baseline, NMFS would then determine whether that reduction constituted an appreciable reduction in the likelihood of survival and recovery. If so, NMFS would conclude that the action would be likely to jeopardize the continued existence of listed species. This decision depends upon the magnitude of the reduction; the distribution of that reduction among component populations and major population groups within an ESU; the risk experienced by the ESU, both over its range and within the action area; and the amount of uncertainty presented by the data and scientific analysis available.

If NMFS determines in Step 3 that the proposed action alters an essential feature of designated critical habitat compared to either of the two reference points (i.e., either the environmental baseline or the condition of the habitat at the time of listing), NMFS would then evaluate whether the alteration constitutes a destruction or adverse modification of designated critical habitat.

In determining whether an alteration of an essential feature of critical habitat compared to either of the reference points appreciably diminishes the value of critical habitat for survival or recovery, NMFS considers the magnitude and duration of the alteration, the condition of critical habitat in the action area under the environmental baseline and cumulative effects, the purpose of the affected essential feature for survival and recovery, the status of the ESU across its range and within the action area, and the amount of uncertainty presented by the data and scientific analysis available.

If NMFS determines that the proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat, it must, if possible, identify a reasonable and prudent alternative to the proposed action that would avoid these effects.

# 2. BACKGROUND

## 2.1 Introduction

This Opinion is the latest in a series of ESA Section 7 consultations conducted since 1997 between USBR and NMFS covering USBR's Upper Snake River Basin irrigation projects.

The previous Upper Snake biological opinion (hereinafter referred to as the 2001 Biological Opinion) was issued on May 2, 2001, at which time NMFS found that the action proposed by the USBR was not likely to jeopardize 12 listed species of salmon and steelhead, or adversely modify their designated critical habitat. The 2001 Biological Opinion was originally issued to cover a one-year period, primarily because ongoing negotiations regarding the disposition of Federal reserved and Native American treaty reserved water right claims were believed to be nearing completion. These negotiations were part of the ongoing Idaho general adjudication of water rights process known as the Snake River Basin Adjudication (SRBA).[10] By November 2001, it had become clear that settlement of the Federal and treaty claims was not going to occur in time to include any settlement-related changes in the USBR's proposed action and allow NMFS and USBR to complete a new consultation before the 2001 Biological Opinion expired on March 31, 2002. On November 7, 2001, USBR therefore requested initiation of formal consultation on the continued operation and maintenance of its Upper Snake projects and submitted an amended biological assessment of effects (USBR 2001). The action proposed in the November 7, 2001, consultation was identical to that considered in the 2001 Biological Opinion. After considering the best science then available, NMFS determined that its previous ESA Section 7(a)(2) determinations continued to be applicable and, therefore, issued a three-year extension of the 2001 Biological Opinion on January 24, 2002, incorporating by reference the 2001 Biological Opinion. Thus the 2001 Biological Opinion remains in effect through March 31, 2005.

Agreement among the United States, the State of Idaho, the Nez Perce Tribe, and various other SRBA parties was reached in spring 2004 and, by late May, all SRBA settlement parties agreed to proceed with actions needed to implement the SRBA Term Sheet of April 20, 2004. The portion of the SRBA settlement requiring Congressional action was included in the Consolidated Appropriations Act, 2005, signed by President George Bush on December 8, 2004. The SRBA Term Sheet informs USBR's proposed action for this consultation as described in its November 2004 Biological Assessment (BA). Thus the USBR's proposed action is consistent with that portion of the settlement pertinent to this consultation – long-term access to up to 487,000 acre-feet of water from storage and natural flow water rights and other measures for the purpose of augmenting flows in the Snake River downstream from Hells Canyon Dam to benefit outmigrating juvenile SR fall chinook salmon.

### 2.1.1 Hatchery Listing Policy and Status Reviews

In a September 12, 2001, order in Alsea Valley Alliance v. Evans, Judge Michael R. Hogan of the U.S. District Court in Eugene, Oregon, found NMFS' definition of an ESU to be a

[10] Although the negotiations that took place were aimed at resolving only the Tribal and Federal water right claims, they became known as the SRBA settlement negotiations and are referred to by that name throughout this Opinion.

permissible interpretation of "distinct population segment" for salmon. However, the Court determined that when NMFS finds that an ESU includes both hatchery and naturally spawned fish, the agency may not permissibly list only the naturally spawned fish as threatened or endangered under the ESA. On these grounds, the Court set aside NMFS' 1998 ESA listing of Oregon Coast coho salmon.

In response to the Alsea decision, NMFS has conducted a review to examine how the logic of the Alsea decision should be applied to those ESUs that include fish reared in hatcheries. This review entailed the development of methods to determine which hatchery fish are part of the same ESU as naturally spawned fish, and how the existence of ESU hatchery fish and their interactions with natural populations affect the prospects for survival of the entire ESU. The review was also extended to address the relationship of resident *O. mykiss* (rainbow or redband trout) to anadromous *O. mykiss* (steelhead) within the same ESU. NMFS' Biological Review Team (BRT) prepared a draft report on the updated status of 26 ESA-listed ESUs and 1 candidate species ESU of salmon and steelhead. This draft report was circulated for technical review and comments by State, tribal, and Federal co-managers. The final report, dated July 2003, can be accessed at www.nwr.NOAA.gov/AlseaResponse/20040528/index.html.

NMFS published its proposed hatchery listing policy in the Federal Register on June 3, 2004 (69 FR 31354), and its proposed rule to revise the listing status of 25 currently listed Pacific salmonid ESUs and to list 2 additional ESUs (including Oregon Coast coho salmon) on June 14, 2004 (69 FR 33102). These proposals include the listing of over 100 hatchery populations of salmon and steelhead and the listing of some resident rainbow trout. Additional information, including details on public meetings held during the comment periods for both proposals, can be found at http://www.nwr.NOAA.gov/AlseaResponse/20040528/ltrstkhldrs.pdf. NMFS must make final decisions on the proposed listing rule by June 14, 2005. Promptly thereafter, notice of those decisions and rules will be sent to the Federal Register for publication. NMFS expects to adopt a final hatchery listing policy several months before issuing the final listing revisions rule. NMFS will use that final policy in making its final listing decisions.

### 2.1.2 Redesignation of Critical Habitat

Critical habitat had been designated for 12 of the species of salmon and steelhead considered in this Opinion. However, on April 30, 2002, the U.S. District Court for the District of Columbia adopted a consent decree resolving the claims in National Homebuilders, et al. v. Evans, Civil Action No. 00-2799 (CKK) (DDC, April 30, 2002). Pursuant to that consent decree, the Court issued an order vacating critical habitat designations for a number of listed salmonid species, including Upper Columbia River spring chinook salmon and steelhead, SR steelhead, Middle Columbia River steelhead, Upper Willamette River chinook salmon and steelhead, Lower Columbia River chinook salmon and steelhead, and Columbia River chum salmon. NMFS proposed new critical habitat designations in the Federal Register (69 FR 74572) on December 14, 2004. The public comment period closed on March 14, 2005, and NMFS expects to publish final critical habitat designations for these listed species in August 2005.

## 2.2 Current Consultation

This Opinion supplants the 2001 Biological Opinion and shall remain in force until March 31, 2035, unless superseded by another biological opinion.

## 2.3 Communication with State and Tribal Representatives

Under Secretarial Order *American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act* (June 5, 1997), NMFS is obligated to notify affected tribes when an action subject to ESA consultation may affect Indian lands, tribal trust resources, or the exercise of American Indian tribal rights, and to solicit any information, traditional knowledge, or comments the tribes may wish to provide to help in our consultation. In fulfillment of that obligation, on January 21, 2005, NMFS sent letters of notification and inquiry to the following tribes and tribal entities (NMFS 2005):

- Burns Paiute Tribe
- Confederated Tribes of the Colville Reservation
- Columbia River Inter-Tribal Fish Commission
- Kalispel Tribe of Indians
- Confederated Salish and Kootenai Tribes
- Nez Perce Tribe
- Shoshone-Bannock Tribes
- Shoshone-Paiute Tribes
- Spokane Tribe of Indians
- Confederated Tribes of the Umatilla Indian Reservation
- Upper Columbia United Tribes
- Confederated Tribes of the Warm Springs Reservation of Oregon
- Confederated Tribes and Bands of the Yakama Nation

Conference calls were held between NMFS and interested tribal staff on February 15, 2005, and March 2, 2005, to discuss the status and schedule of the ESA consultation and biological opinion, present NMFS' analytical methodology and approaches used to analyze the effects of the USBR's proposed action, and share preliminary modeling results. A draft Opinion was sent to interested tribes for review and comment on March 15, 2005. A follow-up meeting with the tribes was held in Boise, Idaho, on March 18, 2005, to further review and discuss the NMFS draft Opinion, present our analytical results and conclusions, and answer questions and solicit comments from the tribes. The USBR also distributed copies of the NMFS draft Opinion to the State of Idaho and other interested SRBA parties.

### 2.4 Recovery Planning

Section 4(f) of the ESA directs NMFS to develop and implement recovery plans for the ESUs addressed in this Opinion. "To the maximum extent practicable," each plan shall incorporate:

- Site-specific actions necessary to achieve goals for conservation and survival.
- Objective measurable criteria for delisting the species.
- Estimates of the time and cost for implementing the recovery plan.

While NMFS is legally responsible for developing and implementing recovery plans, Section 7(a)(1) of the ESA directs all Federal agencies, in consultation with NMFS, to "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species…" NMFS is therefore coordinating work with other Federal agencies throughout the Snake and Columbia Basins through the Federal Caucus that was established during FCRPS consultations.

NMFS and the Federal Caucus believe that the plans will have a greater likelihood of success if developed in partnership with other stakeholders, including those that have the responsibility and authority to implement specific recovery actions. Current efforts that will provide a strong foundation for ESA recovery plans in the Columbia River Basin include the Northwest Power and Conservation Council's (Council) subbasin plans and the State of Washington's regional recovery plans. NMFS is assisting Council subbasin planning and State of Washington recovery planning groups as they develop assessments, strategies, and actions. Initial drafts of subbasin plans have addressed primarily habitat issues, and NMFS is working with local, State, and tribal organizations to integrate hatchery, harvest, and hydro issues into the plans (as described below).

As recovery plans are developed and finalized, they will take into account biological opinions, Habitat Conservation Plans (HCPs), Federal Energy Regulatory Commission (FERC) license agreements, settlement agreements resulting from litigation (e.g., U.S. v. Oregon and U.S. v. Washington), and other existing arrangements. Once completed, the recovery plans are intended to provide a roadmap to recovery. They will provide a context for future biological opinions, HCPs, FERC license renewals, and other actions. They are intended to help organize, coordinate, and prioritize recovery actions to achieve biological goals in the most effective and efficient manner possible.

#### 2.4.1 Status of Recovery Planning

NMFS will finalize recovery plans for all listed Snake and Columbia Basin ESUs that spawn and rear in the State of Washington by June 2005. The first draft of the State of Washington regional recovery plan was received from the Lower Columbia Fish Recovery Board on December 15, 2004. Assuming that the plans are consistent with guidance endorsed by NMFS, including the State of Washington's Salmon Recovery Plan Model and the Council's Technical Guide, NMFS expects to endorse them as "Interim Local Recovery Plans." These plans are considered to be "interim" because they may require the addition of elements for hydro, hatchery, and harvest actions (i.e., some of the Washington Recovery Boards have only addressed habitat actions and therefore need additional components). Washington's regional recovery boards have been coordinating with both Columbia Basin TRTs, and it appears that their recovery plans will address TRT viability recommendations. The status and timing of recovery plans for portions of ESUs in Oregon and Idaho is less clear. Final plans must be developed for the "bi-state" mid-Columbia steelhead and "tri-state" (SR spring/summer chinook salmon, fall chinook salmon, steelhead, and sockeye salmon) ESUs by December 2005.

# 3. PROPOSED ACTION

USBR has proposed 12 separate actions to be considered during this consultation (see Table 1-1). USBR's November 2004 BA and the earlier documents incorporated by reference therein describes the proposed actions under consideration in this Opinion (USBR 2004). Although USBR proposes 12 separate actions (the proposed action, or PA), in accordance with 50 CFR 402.14(c)(6), NMFS and USBR are conducting this consultation on the net effects of these actions on anadromous fish and their habitat downstream from Hells Canyon Dam, the upstream limit of occupied habitat. The PA is in the same geographic region and collectively affects listed salmon and occupied habitat because the effects of the 12 actions come together above Brownlee Reservoir before the species encounter them.

This Opinion also satisfies NMFS' obligation to complete ESA Section 7 consultation on the Snake River Flow Component of the SRBA settlement mediator's term sheet of April 20, 2004 (hereinafter referred to as the SRBA settlement).

## 3.1 Term of this Biological Opinion

In accordance with USBR's BA and the SRBA settlement, the term of this biological opinion covers USBR's proposed action set forth in the BA through March 31, 2035.

# 4. RANGE-WIDE STATUS OF THE LISTED SPECIES

## 4.1 Introduction

The first step NMFS takes when applying ESA Section 7(a)(2) to the listed ESUs considered in this Opinion is to define each ESU's biological requirements and evaluate its range-wide status relative to those biological requirements. Biological requirements are defined in Section 5.4. The range-wide status of each of the listed ESUs considered in this Opinion is summarized in the following sections.

## 4.2 Listed Species Affected by the Proposed Action

In this consultation, NMFS considers whether the effects of the USBR's proposed action is likely to jeopardize the continued existence of 12 listed ESUs and 1 proposed ESU of Snake and Columbia Basin salmonids, or cause the destruction or adverse modification of their designated critical habitat. The 13 ESUs are:

- Snake River (SR) spring/summer chinook salmon (*Oncorhynchus tshawytscha)*; listed as threatened on April 22, 1992 (57 FR 14653); critical habitat designated on December 28, 1993 (58 FR 68543), and revised on October 25, 1999 (64 FR 57399).

- Snake River (SR) fall chinook salmon (*O. tshawytscha)*; listed as threatened on April 22, 1992 (57 FR 14653); critical habitat designated on December 28, 1993 (58 FR 68543).

- Upper Columbia River (UCR) spring chinook salmon (*O. tshawytscha)*; listed as endangered on March 24, 1999 (64 FR 14308); critical habitat designated on February 16, 2000 (65 FR 7764), but vacated by court order on April 30, 2002.[11]

- Upper Willamette River (UWR) chinook salmon (*O. tshawytscha)*; listed as threatened on March 24, 1999 (64 FR 14308); critical habitat designated on February 16, 2000 (65 FR 7764), but vacated by court order on April 30, 2002.

- Lower Columbia River (LCR) chinook salmon (*O. tshawytscha)*; listed as threatened on March 24, 1999 (64 FR 14308); critical habitat designated on February 16, 2000 (65 FR 7764), but vacated by court order on April 30, 2002.

[11]Critical habitat had been designated for 12 of the species of salmon and steelhead considered in this Opinion. However, on April 30, 2002, the U. S. District Court for the District of Columbia adopted a consent decree resolving the claims in National Homebuilders, et al. v. Evans, Civil Action No. 00-2799 (CKK)(D.D.C., April 30, 2002). Pursuant to that consent decree, the Court issued an order vacating critical habitat designations for a number of listed salmonid species, including UCR spring chinook salmon and steelhead, SR steelhead, MCR steelhead, UWR chinook salmon and steelhead, LCR chinook salmon and steelhead, and CR chum salmon. For this reason, the proposed action can only affect designated critical habitat for SR spring/summer chinook salmon, SR fall chinook salmon, and SR sockeye salmon. Thus this Opinion will not determine whether the proposed action is likely to result in the destruction or adverse modification of any critical habitat for 10 of 13 ESUs.

- Snake River (SR) steelhead (*O. mykiss)*; listed as threatened on August 18, 1997 (62 FR 43937); critical habitat designated on February 16, 2000 (65 FR 7764), but vacated by court order on April 30, 2002.

- Upper Columbia River (UCR) steelhead (*O. mykiss)*; listed as endangered on August 18, 1997 (62 FR 43937); critical habitat designated on February 16, 2000 (65 FR 7764), but vacated by court order on April 30, 2002.

- Middle Columbia River (MCR) steelhead (*O. mykiss)*; listed as threatened on March 25, 1999 (64 FR 14517); critical habitat designated on February 16, 2000 (65 FR 7764), but vacated by court order on April 30, 2002.

- Upper Willamette River (UWR) steelhead (*O. mykiss)*; listed as threatened on March 25, 1999 (64 FR 14517); critical habitat designated on February 16, 2000 (65 FR 7764), but vacated by court order on April 30, 2002.

- Lower Columbia River (LCR) steelhead (*O. mykiss)*; listed as threatened on March 19, 1998 (63 FR 13347); critical habitat designated on February 16, 2000 (65 FR 7764), but vacated by court order on April 30, 2002.

- Columbia River (CR) chum salmon (*O. keta)*; listed as threatened on March 25, 1999 (64 FR 14508); critical habitat designated on February 16, 2000 (65 FR 7764), but vacated by court order on April 30, 2002.

- Snake River (SR) sockeye salmon (*O. nerka)*; listed as endangered on November 20, 1991 (56 FR 58619); critical habitat designated on December 28, 1993 (58 FR 68543).

- Lower Columbia River (LCR) coho salmon (*O. kisutch)*; proposed for listing as threatened on June 14, 2004 (69 FR 33102).

On June 14, 2004, NMFS published its proposed ESU listing determinations for Pacific salmon and steelhead in the Federal Register in response to the Alsea decision (hereinafter the 2004 Status Review, Section 2.1.3). Of the 12 ESUs considered in the 2000 Opinion, NMFS has proposed a change in status only for UCR steelhead (from endangered to threatened). Also, NMFS proposes to add over 100 hatchery populations and resident populations of *O. mykiss.*

The June 14, 2004, Federal Register Notice also included a proposal to list LCR coho salmon as threatened. The ESA requires that the Federal Action Agencies (U.S. Army Corps of Engineers [Corps], USBR, and the Bonneville Power Administration [BPA])confer with NMFS on any agency action that is likely to jeopardize the continued existence of any species proposed to be listed or result in the destruction or adverse modification of critical habitat proposed to be designated for such species (ESA Section 7(a)(4)). As indicated, with one exception, NMFS is proposing a revision to a current listing rather than a new listing proposal. The USBR has requested consultation on the current listings. It has not requested conferencing on the revision, and NMFS concurs that conferencing is not required in addition to the present consultation on the existing listings. For the one ESU that NMFS is presently proposing to list, LCR coho salmon, a conference is also unnecessary, given that the Opinion concludes that the proposed action is not likely to jeopardize the continued existence of this ESU and that critical habitat has not been proposed or designated.

Although the listing determinations are not yet final, NMFS uses the same information in this chapter that was used in the proposed listing determinations because it remains the best available scientific and commercial information on the range-wide status of the potentially affected ESUs.

## 4.3 Current Range-wide Status of Listed Species Affected by the Proposed Action

Before NMFS assesses the current status of the listed species within the action area, it reviews the reasons it decided that those species should be listed for ESA protection. It also considers any new data relevant to those determinations. The listing status, general life history, and population dynamics of each species are described in detail in the 2004 Status Review. This information is summarized in the following sections, along with more recent dam and spawner counts for the years after 2001, where available, and updated population trends.

Consideration of Recent Ocean Conditions in the Listing Determinations

In the last decade, evidence has shown recurring, decadal-scale patterns of ocean-atmosphere climate variability in the North Pacific Ocean. These oceanic productivity "regimes" have correlated with salmon population abundance in the Pacific Northwest and Alaska. Survival rates in the marine environment are strong determinants of population abundance for Pacific salmon and steelhead. However, because the confidence with which ocean-climate regimes can be predicted into the future is limited, man's ability to project the future influence of ocean-climate conditions on salmonid productivity is limited. Even under the most optimistic scenario, increases in abundance might be only temporary and could mask a failure to address underlying factors for decline. It is reasonable to assume that salmon populations have persisted over time under pristine conditions through many such cycles in the past. Less certain is how the populations will fare in periods of poor ocean survival when their freshwater, estuary, and nearshore marine habitats are degraded.

### 4.3.1 SR Spring/Summer Chinook Salmon

#### 4.3.1.1 ESU Structure

Based on genetic and geographic considerations, the Interior TRT (2003) established five major population groups in this ESU: the Lower Snake River Tributaries, the Grande Ronde and Imnaha Rivers, the South Fork Salmon River, the Middle Fork Salmon River, and the Upper Salmon River. The Interior TRT further subdivided these groupings into a total of 31 extant, demographically independent populations (Appendix B, Figure B-1). However, chinook salmon have been extirpated from the Snake River and its tributaries above Hells Canyon Dam, an area that encompassed about 50% of the pre-European spawning areas in the Snake River Basin (NRC 1996). Major subbasins in the Clearwater were blocked to chinook salmon in 1927 by the Lewiston Dam. Although the number of spring-run spawning aggregations that were lost due to construction of the Snake River mainstem dams is unknown, the ESU still has a wide spatial distribution in a variety of locations and habitat types.

#### 4.3.1.2 The BRT Findings

NMFS recently conducted a status review of the SR spring/summer chinook salmon and other ESUs. As part of that status review, NMFS convened a BRT to evaluate the available scientific data. The BRT analysis included dam counts and spawner returns for natural-origin fish through 2001. As indicated in Section 1, NMFS must examine the criteria for a sufficient number and distribution of VSPs in order to assess the range-wide biological requirements of the ESU. The BRT did the same thing in assessing whether or not the ESU should be listed as an endangered or threatened species. In this case, the BRT found that, compared to the levels needed for a healthy species, there was a moderately high risk that the abundance and productivity criteria were not currently being met and a low risk that the spatial structure and diversity criteria were not currently being met. Concerns regarding diversity were somewhat alleviated, because out-of-ESU Rapid River broodstock had been phased out of the Grande Ronde. Despite the recent positive signs, the BRT still felt that the ESU was at some level of risk.

#### 4.3.1.3 2004 Status Review

An indicator of the current range-wide status of this ESU is the number of spawners returning to natural production areas. In 1995, NMFS established abundance levels for natural production areas that would be indicative of a recovered population (NMFS 1995b), and these levels were updated as “interim abundance and productivity targets” in 2002 (NMFS 2002). Many, but not all of the 29 extant natural production areas within this ESU have experienced large increases in the number of returning spawners in the last 2 to 3 years, with two populations (Grande Ronde and Imnaha) nearing the previously specified recovery abundance levels. Due to the severe declines in the populations since the 1960s and the short-term nature of the recent high returns, long-term productivity trends remain below replacement for all natural production areas, despite the recent increases. However, the short-term productivity trends for the majority of the natural production areas in the ESU are at or above replacement, which is a positive sign.

During the Status Review, NMFS evaluated whether conservation efforts, such as the extensive artificial propagation program, within this ESU reduced or eliminated the risk to SR spring/summer chinook salmon. In performing this analysis, NMFS was guided by the NMFS/USFWS “Policy for Evaluation of Conservation Efforts When Making Listing Decisions” (“PECE,” 68 FR 15100; March 28, 2003). NMFS concluded that the artificial propagation programs did provide benefits to the ESU in terms of abundance, spatial structure, and diversity, but that the programs had neutral or uncertain effects in terms of overall ESU productivity. As a result, NMFS did not believe that the artificial propagation programs were sufficient to substantially reduce the long-term extinction risk of the ESU. Thus, even though the ESU is likely to benefit from strong upcoming brood years,[12] NMFS proposed to retain the current listing of this species as threatened (i.e., likely to become an endangered species within the foreseeable future). Actions under the 2000 FCRPS Biological Opinion and improvements in hatchery practices are addressing some of the ESU’s factors for decline.

[12]That is, the upcoming brood years were derived from strong spawning escapements and improved conditions during the ocean phase of the life cycle.

#### 4.3.1.4 Recent Dam Counts and Returns to the Spawning Grounds

Cooney (2004) updated the spawner count data used by the BRT (2003) for use by the Interior Columbia Basin TRT, adding data for 2002 and 2003, which he requested from the co-managers. In general, for most of the 24 populations where recent data were available, indices of abundance (i.e., redd counts) for natural-origin SR spring/summer chinook salmon were high in 2002 and 2003 compared to the 1990s. Fisher and Hinrichsen (2004) provided a preliminary evaluation of the effects of recent natural-origin spring chinook salmon returns on past geometric mean abundance levels and population trends. The latter were calculated as the slope of the regression line for the (log transformed) index of abundance over time. They assessed whether the geomean was greater when calculated from the most recent data (beginning in 2001) compared to a base period (1996-2000) and whether the trend was greater when counts for 2001-2003 were added to the 1990-2000 data series. Their methods were taken from those used by NMFS' BRT (2003). The geomean for 2001-2003 (33,581) exhibited a 548% increase over the 1996-2000 base period (5,186 fish). The slope of the trend for the natural-origin population increased 17% (from 0.97 to 1.14) when the data for 2001-2003 were added to the 1990-2000 series, reversing the decline and indicating that, at least for the short-term, the natural-origin population has been increasing. Hatchery fish constituted 69% of the return during the recent period compared to an average of 60% during 1990-2000 (Fisher 2004). Even so, natural-origin fish exhibited the substantial increase in numbers described above. Neither the BRT nor the Interior TRT has reviewed Fisher and Hinrichsen (2004) or Fisher (2004).

### 4.3.2 SR Fall Chinook Salmon

#### 4.3.2.1 ESU Structure

A majority of the fish in this ESU spawn in the mainstem Snake River between the head of Lower Granite Reservoir and Hells Canyon Dam, with the remaining fish distributed among lower sections of the major tributaries (Connor et al. 2002). Fish in the mainstem Snake appear to be distributed in a series of aggregates from the mouth of Asotin Creek to River Mile (RM) 219, although smaller numbers have been reported spawning in the tailraces of the Lower Snake dams (Connor et al. 1993; Dauble et al. 1995). Due to their proximity and the likelihood that individual tributaries could not support a sufficiently large population, the Interior TRT (2003) considered these aggregates and the associated reaches in the lower major tributaries to the Snake to be a single population (Appendix B, Figure B-2). This is consistent with past practice in prior biological opinions.

Before European impact, Snake River fall chinook salmon are believed to have once occupied and spawned in the mainstem Snake River from its confluence with the Columbia River upstream to Shoshone Falls (RM 615). The spawning grounds between Huntington, Oregon (RM 328) and Auger Falls in Idaho (RM 607) were historically the most important for this species. Historically, only limited spawning activity occurred downstream of RM 273 (Waples et al. 1991), which is about one mile below Oxbow Dam. However, the development of irrigation and hydropower projects on the mainstem Snake River has inundated or blocked access to most of this area in the past century. Construction of Swan Falls Dam (RM 458) in

1901 eliminated access to 157 miles (about 25%) of total potential habitat, leaving 458 miles of habitat. Construction of the Hells Canyon Dam complex (1958-1967) cut off anadromous fish access to 211 miles (or 46%) of the remaining historical fall chinook salmon habitat upstream of RM 247. Additional fall chinook salmon habitat was lost through inundation as a result of the construction of the four lower mainstem Snake River dams. Currently, SR fall chinook salmon have access to approximately 100 miles of mainstem Snake River habitat, which is roughly 22% of the 458 miles of historical habitat available prior to completion of the Hells Canyon Complex and the four lower Snake River dams. Historical use of habitat in the Clearwater River is uncertain. Tiffan et al. (2001) concluded that there was "no conclusive evidence" whether the lower Clearwater River supported the basin subyearling migrant life-history pattern associated with Snake River fall chinook salmon.

#### 4.3.2.2 The BRT Findings

Approximately 80% of historical spawning habitat was lost with the construction of a series of dams on the mainstem Snake River. The loss of spawning habitat, restricting the extant ESU to a single naturally spawning population, increased the ESU's vulnerability to environmental variability and catastrophic events. The diversity associated with populations that once resided above the Snake River dams has been lost, and the impact of out-of-ESU fish straying to the spawning grounds has the potential to further compromise the genetic diversity of the ESU. Although recent improvements in the marking of out-of-ESU hatchery fish and their removal at Lower Granite Dam have reduced the impact of these strays, introgression below Lower Granite Dam remains a concern. The BRT found moderately high risk for all VSP categories and therefore felt that, despite the recent positive signs, the ESU was at some level of risk.

#### 4.3.2.3 2004 Status Review

During the Status Review, NMFS evaluated whether artificial propagation programs within this ESU reduce or eliminate risks to its viability, guided by the PECE policy (Section 4.3.1). NMFS concluded that the artificial propagation programs have provided benefits to the ESU in terms of abundance, spatial distribution, and diversity in recent years, although the contribution of these programs to overall ESU productivity is uncertain and the artificial propagation programs are not sufficient to substantially reduce the long-term risk of extinction. Depending upon the assumption made about the likelihood of the progeny of hatchery fish returning as productive adults, long- and short-term trends in productivity are at or above replacement. Thus, NMFS proposed to retain the current listing of this species as threatened (i.e., likely to become an endangered species within the foreseeable future) even though it is not likely to go extinct in the near future. Actions under the 2000 FCRPS Biological Opinion and improvements in hatchery practices have provided some encouraging signs in addressing the ESU's factors for decline.

#### 4.3.2.4 Recent Dam Counts and Returns to the Spawning Grounds

Cooney (2004) reported that the high counts of natural-origin SR fall chinook salmon continued in 2002 and 2003 (2,114 and 3,896 adults at Lower Granite Dam, respectively). In their preliminary analysis of recent returns, Fisher and Hinrichsen (2004) reported that the geometric mean abundance of naturally-produced fall chinook salmon was 3,462 during 2001-2003, compared to 694 in 1996-2000 (a 398% increase). The slope of the population trend increased 8.0% (from 1.16 to 1.24) when the data for 2001-2003 were added to the 1990-2000 series. These results indicate that, at least for the short-term, the population has been increasing. Approximately 64% of the aggregate run at Lower Granite Dam was hatchery fish in 2001-2003, compared to 67% during 1990-2000 (Fisher 2004).

### 4.3.3 UCR Spring Chinook Salmon

#### 4.3.3.1 ESU Structure

The Interior TRT (2003) identified one major population group consisting of three demographically independent populations in the UCR spring chinook salmon ESU (Appendix B, Figure B-3). Due to the relatively small size of the area, they did not identify any major groupings. Within the current boundary of the ESU, spring chinook salmon are considered extirpated from the Okanogan drainage. The historical status of spring-run, stream-type fish belonging to this ESU in the Okanogan is uncertain. The Interior TRT could not determine definitively whether an independent population of UCR spring chinook salmon existed there in the past but recognized the possibility that the area may have supported one. The construction of Grand Coulee Dam in 1939 blocked access to over 50% of the river miles formerly available to UCR spring chinook salmon (NRC 1996). Tributaries in this blocked area may have supported one or more populations, but the lack of data on distribution and genetic makeup made it impossible for the Interior TRT to make any definitive determination.

#### 4.3.3.2 The BRT Findings

The five hatchery spring-run chinook salmon populations considered to be part of this ESU are programs aimed at supplementing natural production areas. These programs have contributed substantially to the abundance of natural spawners in recent years. However, little information is available to assess the impact of these high levels of supplementation on the long-term productivity of natural populations. The BRT (2003) concluded that spatial structure in this ESU was of little concern, because there is passage and connectivity among almost all populations. During years of critically low escapement (1996 and 1998), extreme management measures were taken in one of the three major spring chinook salmon producing basins where all returning adults were collected and taken into the hatchery supplementation programs, reflecting the ongoing vulnerability of certain segments of this ESU. The BRT expressed concern that these actions, while appropriately guarding against the catastrophic loss of populations, may have compromised ESU population structure and diversity. The BRT's assessment of risk for the four VSP categories reflects strong concerns regarding abundance and productivity and comparatively less concern for ESU spatial structure and diversity (BRT 2003).

#### 4.3.3.3 2004 Status Review

In its Status Review, NMFS' assessment of the effects of artificial propagation concluded that the within-ESU hatchery programs do not substantially reduce the extinction risk of the ESU in total (NMFS 2004c). Protective efforts, as evaluated pursuant to the PECE, did not alter NMFS' assessment that the ESU is in danger of extinction or likely to become so in the foreseeable future. Actions under the 2000 FCRPS Biological Opinion, Federally funded habitat restoration efforts, and other protective efforts are encouraging signs in addressing the ESU's factors for decline, but they do not as yet substantially reduce the ESU's extinction risk. Artificial propagation practices within the geographic range of the ESU do not fully support the conservation and recovery of UCR spring-run chinook salmon. In particular, NMFS is concerned that the non-ESU Entiat National Fish Hatchery has compromised the genetic integrity of the native natural population of spring-run chinook salmon in the Entiat Basin.

#### 4.3.3.4 Recent Dam Counts and Returns to the Spawning Grounds

Cooney (2004) reported that natural-origin returns to the Methow subbasin in 2002 and to the Entiat and Wenatchee during 2002 and 2003 continued to exceed those observed during much of the 1990s. However, returns to the Methow declined during 2003. In their preliminary analysis, Fisher and Hinrichsen (2004) reported that the geometric mean of aggregate numbers of UCR spring chinook salmon increased 1,038% from 1996-2000 (4,959) to 2001-2003 (436 fish). The slope of the aggregate population trend increased 9.3% (from 1.00 to 1.10) when the data for 2001-2003 were added to the 1990-2000 series. These results indicate that, at least in the short-term, the aggregate population and the natural-origin populations in the Entiat and Wenatchee subbasins have been increasing.

### 4.3.4 UWR Chinook Salmon

#### 4.3.4.1 ESU Structure

The Willamette/Lower Columbia River (W/LC) TRT (McElhany et al. 2004) identified seven demographically independent populations of UWR chinook salmon in a single major group (Appendix B, Figure B.4). All of these populations are extant, although they vary in degree of viability.

#### 4.3.4.2 The BRT Findings

Numbers passing Willamette Falls have remained relatively steady over the past 50 years (ranging from approximately 20,000 to 75,000), but are an order of magnitude below the peak abundance levels observed in the 1920s (approximately 300,000 adults). The Clackamas and McKenzie River populations have shown substantial increases in total abundance since 2000. Trends in the other populations are difficult to determine. However, interpretation of the difference in abundance levels for the other populations remains confounded by a high but uncertain fraction of hatchery-origin fish.

The BRT estimated that, despite improving trends in total productivity since 1995, productivity would be below replacement in the absence of artificial propagation. The BRT was particularly concerned that a majority of the historical spawning habitat and approximately 30% to 40% of total historical habitat are now inaccessible behind dams. The restriction of natural production to just a few areas increases the ESU's vulnerability to environmental variability and catastrophic events. Losses of local adaptation and genetic diversity through the mixing of hatchery stocks within the ESU and the introgression of out-of-ESU hatchery fall-run chinook salmon represent threats to ESU diversity. However, the BRT was encouraged by the recent closure of the fall-run hatchery and by improved marking rates of hatchery fish to assist in monitoring and in the management of a marked-fish selective fishery. The BRT found moderately high risks for all VSP categories.

**4.3.4.3 2004 Status Review**

There are no direct estimates of total natural-origin spawner abundance for the UWR chinook salmon ESU. The abundance of the aggregate run passing Willamette Falls has remained relatively steady over the past 50 years (ranging from approximately 20,000 to 70,000 fish), but is only a fraction of peak abundance levels observed in the 1920s (approximately 300,000 adults). Interpretation of abundance levels is confounded by a high but uncertain fraction of hatchery-produced fish. The McKenzie River population has shown substantial increases in total abundance (hatchery origin and natural origin fish) in the last 2 years, while trends in other natural populations in the ESU are generally mixed. With the relatively large incidence of hatchery fish spawning in the wild, it is difficult to determine trends in productivity for natural-origin fish.

Seven artificial propagation programs in the Willamette River produce fish that are considered to be part of the UWR chinook salmon ESU. All of these programs are funded to mitigate for lost or degraded habitat and produce fish for harvest purposes. During the Status Review, NMFS' assessment of the effects of artificial propagation concluded that these hatchery programs collectively do not substantially reduce the extinction risk of the ESU (NMFS 2004c). An increasing proportion of hatchery-origin returns has contributed to increases in total ESU abundance. However, it is unclear whether these returning hatchery and natural fish actually survive over winter to spawn. Estimates of pre-spawning mortality indicate that a high proportion (more than 70%) of spring chinook salmon in most ESU populations die before spawning. In recent years, hatchery fish have been used to reintroduce spring chinook salmon back into historical habitats above impassible dams (e.g., in the North Santiam, McKenzie, and Middle Fork Willamette Rivers), slightly decreasing risks to ESU spatial structure. Within-ESU hatchery fish exhibit different life-history characteristics from natural ESU fish. High proportions of hatchery-origin natural spawners in remaining natural production areas (i.e., in the Clackamas and McKenzie Rivers) may thereby have negative impacts on within- and among-population genetic and life-history diversity. Collectively, artificial propagation programs in the ESU have a slight beneficial effect on ESU abundance and spatial structure but neutral or uncertain effects on ESU productivity and diversity. Protective efforts, as evaluated pursuant to the PECE, did not alter the assessments of the BRT and the Artificial Propagation Evaluation Workshop participants that the ESU is "likely to become endangered within the foreseeable future." The USFWS Greenspaces Program, the Oregon Plan, hatchery reform efforts, and other protective initiatives are encouraging signs. However, restoration efforts in the ESU are very local in scale and have yet to provide benefits at the scale of watersheds or at the larger spatial scale of the ESU. The blockage of historical spawning habitat and the restriction of natural production areas remain to be addressed.

#### 4.3.4.4 Recent Dam Counts and Returns to the Spawning Grounds

Fisher and Hinrichsen (2004) report that the preliminary geometric mean aggregate abundance of UWR chinook salmon in the Clackamas and McKenzie Rivers is equal to 12,530 for 2001-2003, compared to 3,041 in 1996-2000, a 312% increase. The slope of the aggregate population trend increased 15.2% (from 0.89 to 1.02) when the data for 2001-2003 were added to the 1990-2000 series, reversing the decline and indicating that, at least in the short-term, the aggregate population has been increasing.

### 4.3.5 LCR Chinook Salmon

#### 4.3.5.1 ESU Structure

The W/LC TRT (McElhany et al. 2004) identified a total of 23 extant, demographically independent populations in six major population groups: the Coastal fall-run, Cascade fall-run, Cascade late fall-run, Cascade spring-run, Gorge fall-run, and Gorge spring-run (Appendix B, Figures B.5a and B.5b).

#### 4.3.5.2 The BRT Findings

Abundance estimates of naturally produced spring chinook salmon have improved since 2001 due to the marking of all hatchery spring chinook salmon releases (compared to a previous marking rate of only 1% to 2%), which allows for the separation in counts at weirs and traps and on spawning grounds. Despite recent improvements, long-term trends in productivity are below replacement for the majority of populations. Of the historical populations, 8 to 10 have been extirpated or nearly extirpated. Although approximately 35% of historical habitat has been lost behind impassable barriers, the ESU exhibits a broad spatial distribution in a variety of watersheds and habitat types. Natural production currently occurs in approximately 20 populations, although only one population has a mean spawner abundance exceeding 1,000 fish.

The BRT expressed concern that most of the extirpated populations are spring-run, and the disproportionate loss of this life history type represents a risk to ESU diversity. Additionally, of the 4 hatchery spring-run chinook salmon populations considered to be part of the ESU, 2 are propagated in rivers that, although they are within the historical geographic range of the ESU, probably did not support spring-run populations. High hatchery production poses genetic and ecological risks to the natural populations and complicates assessments of their performance. The BRT also expressed concern over the introgression of out-of-ESU hatchery stocks. The BRT found moderately high risk for all VSP categories.

#### 4.3.5.3 2004 Status Review

In its Status Review, NMFS notes that many populations within the LCR chinook salmon ESU have exhibited pronounced increases in abundance and productivity in recent years, possibly due to improved ocean conditions. Abundance estimates of naturally spawned populations have been uncertain until recently due to a high (approximately 70%) fraction of naturally spawning hatchery fish. Abundance estimates of naturally-produced spring chinook salmon have improved since 2001 due to the marking of all hatchery spring chinook salmon releases (compared to a previous marking rate of only 1% to 2%), which allows for the separation in counts at weirs and traps and on spawning grounds. Despite recent improvements, long-term trends in productivity through 2001 were below replacement for the majority of populations in the ESU. Of the historical populations, 8 to 10 were extirpated or nearly extirpated. Although approximately 35% of historical habitat is behind impassable barriers, the ESU exhibits a broad spatial distribution in a variety of watersheds and habitat types. Natural production occurs in approximately 20 populations, although as of 2001, only one population had a mean spawner abundance exceeding 1,000 fish.

Seventeen artificial propagation programs releasing hatchery chinook salmon are considered part of the LCR chinook salmon ESU. All of these programs are designed to produce fish for harvest, and three of these programs are also intended to augment naturally spawning populations in the basins where the fish are released. These three programs integrate naturally produced spring chinook salmon into the broodstock in an attempt to minimize the genetic effects of returning hatchery adults that spawn in the wild.

During the 2004 Status Review, NMFS' assessment of the effects of artificial propagation concluded that these hatchery programs do not substantially reduce the extinction risk of the ESU in total (NMFS 2004c). Although the hatchery programs have been successful at producing substantial numbers of fish, thereby reducing risks to ESU abundance, their effect on the productivity of the ESU in total is uncertain. Additionally, the high level of hatchery production in this ESU poses potential genetic and ecological risks to the ESU and confounds the monitoring and evaluation of abundance trends and productivity. The Cowlitz River spring chinook salmon program releases parr into the Upper Cowlitz River Basin in an attempt to reestablish a naturally spawning population above Cowlitz Falls Dam. Such reintroduction efforts increase the ESU's spatial distribution into historical habitats and slightly reduce risks to ESU spatial structure. The few programs that regularly integrate natural fish into the broodstock may help preserve genetic diversity within the ESU. However, the majority of hatchery programs in the ESU have not converted to the practice of regularly incorporating natural broodstock, thus limiting this risk-reducing feature at the ESU scale. Past and ongoing transfers of broodstock among hatchery programs in different basins represent risks to within- and among-population diversity. Collectively, artificial propagation programs in the ESU provide slight benefits to ESU abundance, spatial structure, and diversity but have neutral or uncertain effects on productivity.

NMFS' assessment of the effects of artificial propagation concluded that the within-ESU hatchery programs do not substantially reduce the risk of the ESU in total (NMFS 2004c). Protective efforts, as evaluated pursuant to the PECE, did not alter NMFS' assessment that the

ESU is "likely to become endangered within the foreseeable future." Planned dam removals on the Sandy River, Federally funded habitat restoration efforts, the Washington Department of Natural Resources HCP, and other protective efforts are encouraging signs that the ESU's factors for decline are being addressed, but they do not as yet substantially reduce threats to the ESU.

#### 4.3.5.4 Recent Dam Counts and Returns to the Spawning Grounds

Fisher and Hinrichsen (2004) compared the aggregate abundance of 41,450 during 2001 to a geomean of 11,135 for the years 1996-2000, a 272% increase. The slope of the aggregate population trend increased 6.6% (from 0.76 to 1.03) when the count for 2001 was added to the 1990-2000 data series, reversing the decline and indicating that, at least in the short-term, the aggregate population is increasing.

### 4.3.6 SR Steelhead

#### 4.3.6.1 ESU Structure

The Interior TRT (2003) identified 23 populations[13] in 6 major population groups in this ESU: the Clearwater River, the Grande Ronde River, Hells Canyon, the Imnaha River, the Lower Snake River, and the Salmon River (Appendix B, Figure B.6). Like SR spring/summer chinook salmon, SR steelhead were blocked from portions of the Upper Snake River beginning in the late 1800s and culminating with the construction of Hells Canyon Dam in the 1960s.

The SR steelhead ESU includes all naturally spawned populations of steelhead (and their progeny) in streams in the Snake River Basin of southeast Washington, northeast Oregon, and Idaho (62 FR 43937; August 18, 1997).

NMFS' June 14, 2004, listing proposal did not resolve the ESU membership of native resident populations that are above recent (usually manmade) impassable barriers but below natural barriers. It was provisionally proposed that these resident populations not be considered part of the revised SR *s*teelhead ESU until such time as significant scientific information becomes available to afford a case-by-case evaluation of their ESU relationships. There was one exception in the listing proposal: recent genetic data suggest that native resident steelhead above Dworshak Dam on the North Fork Clearwater River are part of the ESU. However, NMFS did not propose that hatchery rainbow trout introduced to the Clearwater River (and other areas within the ESU) be included in the ESU. The presence of 6 major population groups in this ESU means that it is less likely that any single group is significant for this ESU's survival and recovery, compared to ESUs with fewer major population groups.

#### 4.3.6.2 The BRT Findings

The BRT (2003) noted that the ESU remains spatially well distributed in each of the six major geographic areas in the Snake River Basin. However, the Snake River Basin steelhead "B run"[14]

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[13]The Interior TRT (2003) identified one additional group of tributaries, Hells Canyon, which members thought was not large enough to support a demographically independent population.

[14] B-run steelhead have a 2-year ocean residence and larger body size and are believed to be produced only in the Clearwater, Middle Fork Salmon, and South Fork Salmon Rivers.

was particularly depressed. The BRT was also concerned about the predominance of hatchery-origin fish in this ESU, the inferred displacement of naturally produced fish by hatchery-origin fish, and potential impacts on ESU diversity. High straying rates exhibited by some hatchery programs generated concern about the possible homogenization of population structure and diversity. However, recent efforts to improve the use of local broodstock and release hatchery fish away from natural production areas are encouraging. For many BRT members, the presence of relatively numerous resident fish reduces risks to ESU abundance but provides an uncertain contribution to ESU productivity, spatial structure, and diversity (NMFS 2003, 2004b). The BRT found moderate risk for the abundance, productivity, and diversity VSP categories and comparatively lower risk in the spatial structure category.

#### 4.3.6.3 2004 Status Review

The paucity of information on adult spawning escapement for specific tributary production areas in the SR steelhead ESU made a quantitative assessment of viability difficult. Annual return estimates are limited to counts of the aggregate return over Lower Granite Dam, and spawner estimates for the Tucannon, Grande Ronde, and Imnaha Rivers. The 2001 return over Lower Granite Dam was substantially higher relative to the low levels seen in the 1990s; the recent 5-year mean abundance (14,768 natural returns) approximately 28% of the interim recovery target level. The abundance surveyed in sections of the Grande Ronde, Imnaha, and Tucannon Rivers was generally improved in 2001. However, recent 5-year abundance and productivity trends (through 2001) were mixed. Five of the nine available data series exhibit positive long- and short-term trends in abundance. The majority of long-term population growth rate estimates for the nine available series were below replacement. The majority of short-term population growth rates (through 2001) were marginally above replacement or well below replacement, depending upon the assumption made regarding the effectiveness of hatchery fish in contributing to natural production.

There are six artificial propagation programs producing steelhead in the Snake River Basin that are considered to be part of the ESU. Artificial propagation enhancement efforts occur in the Imnaha River (Oregon), Tucannon River (Washington), East Fork Salmon River (Idaho, in the initial stages of broodstock development), and South Fork Clearwater River (Idaho). In addition, Dworshak Hatchery acts as a gene bank to preserve the North Fork Clearwater River “B-run” steelhead population, which no longer has access to historical habitat due to construction of Dworshak Dam. During the Status Review, NMFS’ assessment of the effects of artificial propagation concluded that these hatchery programs collectively do not substantially reduce the extinction risk of the ESU in total (NMFS 2004c). Snake River Basin hatchery programs may be providing some benefit to the local target, but only the Dworshak-based programs have appreciably benefited the total number of adult spawners. The Little Sheep Hatchery program is contributing to total abundance in the Imnaha River but has not contributed to increased natural productivity. The Tucannon and East Fork Salmon River programs were only recently initiated and have yet to produce appreciable adult returns. Thus, the overall contribution of the hatchery programs in reducing risks to ESU abundance is small, and the contribution of ESU hatchery programs to the productivity of the ESU in total is uncertain. Most returning Snake River Basin hatchery steelhead are collected at hatchery weirs or have access to unproductive mainstem habitats, limiting potential contributions to the productivity of the entire ESU. The artificial propagation programs affect only a small portion of the ESU's spatial distribution and confer only slight benefits to ESU spatial structure. Large steelhead programs not considered to be part of the ESU occur in the mainstem Snake, Grande Ronde, and Salmon Rivers and may adversely affect ESU diversity. These out-of-ESU programs are currently undergoing review to determine the level of isolation between the natural and hatchery stocks and to define what reforms may be needed. Collectively, artificial propagation programs in the ESU provide a slight beneficial effect to ESU abundance and spatial structure but have neutral or uncertain effects on ESU productivity and diversity.

#### 4.3.6.4 Recent Dam Counts and Returns to the Spawning Grounds

The lack of information on adult spawning escapement to many tributary production areas makes it difficult to assess quantitatively the viability of the SR steelhead ESU. Estimates of annual returns are limited to estimates of aggregate numbers over Lower Granite Dam and spawner estimates for the Tucannon, Grande Ronde, and Imnaha Rivers. Cooney (2004) reported continuing high returns of natural-origin SR steelhead (both A- and B-run fish) during 2002 and 2003 compared to those observed during much of the 1990s. In their preliminary report, Fisher and Hinrichsen (2004) estimated that the geometric mean of the natural-origin run was 37,784 during 2001-2003, a 253% increase over the 1996-2000 period (10,694 steelhead). The slope of the population trend increased 9.3% (from 1.00 to 1.10) when the counts for 2001-2003 were added to the 1990-2000 data series. These data indicate that, at least in the short-term, the natural-origin run has been increasing.

### 4.3.7 UCR Steelhead

#### 4.3.7.1 ESU Structure

The Interior TRT (2003) identified four historical, demographically independent populations in a single major population group in this ESU (Appendix B, Figure B.7). As described above for UCR spring chinook salmon, the construction of Grand Coulee Dam in 1939 blocked access to over 50% of the river miles formerly available to UCR steelhead (NRC 1996). Tributaries in this blocked area may have supported one or more populations, but the lack of data on distribution and genetic makeup made it impossible for the Interior TRT to make a definitive determination.

The UCR steelhead ESU includes all naturally spawned populations of steelhead in streams in the Columbia River Basin upstream from the Yakima River in Washington to the United States-Canada border (62 FR 43937; August 18, 1997).

NMFS' June 14, 2004, listing proposal did not resolve the ESU membership of native resident populations that are above recent (usually man-made) impassable barriers but below natural barriers. It was provisionally proposed that these resident populations not be considered part of the revised UCR steelhead ESU, until such time as significant scientific information becomes available, thereby affording a case-by-case evaluation of their ESU relationships.

#### 4.3.7.2 The BRT Findings

The BRT (2003) was concerned about the general lack of detailed information regarding the productivity of natural populations. The extremely low replacement rate of naturally spawning fish (0.25-0.30 at the time of the last status review in 1998) does not appear to have improved appreciably. The predominance of hatchery-origin natural spawners (approximately 70% to 90% of adult returns) is a significant source of concern for the diversity of the ESU and generates uncertainty about long-term trends in natural abundance and productivity. The natural component of the anadromous run over Priest Rapids Dam has increased from an average of 1,040 (1992-1996) to 2,200 (1997-2001). This pattern, however, is not consistent for other production areas within the ESU. The mean proportion of natural-origin spawners declined by 10% from 1992-1996 to 1997-2001. For many BRT members, the presence of relatively numerous resident fish reduced risks to ESU abundance but provided an uncertain contribution to ESU productivity, spatial structure, and diversity (NMFS 2003, 2004b). The BRT found high risk for productivity and comparatively lower risk for abundance, diversity, and spatial structure.

#### 4.3.7.3 2004 Status Review

In its Status Review, NMFS reported that the last 2-3 years (through 2001) had seen an encouraging increase in the number of naturally produced fish in the UCR steelhead ESU. The 1996-2001 average aggregate return through the Priest Rapids Dam fish ladder (just below the upper Columbia steelhead production areas) was approximately 12,900 total adults, compared to 7,800 adults for 1992–1996. However, the recent 5-year mean abundances (through 2001) for naturally spawned populations in this ESU were 14% to 30% of their interim recovery target abundance levels.

Six artificial propagation programs that produce hatchery steelhead are considered to be part of the UCR steelhead ESU. These programs are intended to contribute to the recovery of the ESU by increasing the abundance of natural spawners, increasing spatial distribution, and improving local adaptation and diversity (particularly with respect to the Wenatchee River steelhead). Research projects to investigate the spawner productivity of hatchery-reared fish are being developed. Some of the hatchery-reared steelhead adults that return to the basin may be in excess of needs of the naturally spawning population in years when survival is high, potentially posing a risk to the natural-origin component of the ESU. The artificial propagation programs included in this ESU adhere to strict protocols for the collection, rearing, maintenance, and mating of the captive brood populations. Genetic evidence suggests that these programs remain closely related to the naturally spawned populations and maintain local genetic distinctiveness of populations within the ESU. HCPs with the Chelan and Douglas Public Utility Districts and binding mitigation agreements ensure that these programs will have secure funding and will therefore continue into the future. These hatchery programs have undergone ESA Section 7 consultation to ensure that they do not jeopardize the recovery of the ESU and have received ESA Section 10 permits for production though 2007. Annual reports and other specific information reporting requirements are used to ensure that the terms and conditions specified by NMFS are followed. These programs, through adherence to best professional practices, have not experienced disease outbreaks or other catastrophic losses.

During the Status Review, NMFS' assessment of the effects of artificial propagation concluded that hatchery programs collectively mitigate the immediacy of extinction risk for the UCR steelhead ESU in total in the short-term, but the contributions of these programs to the long-term survival and recovery of the species is uncertain (NMFS 2004c). The ESU hatchery programs substantially increase total ESU returns, particularly in the Methow Basin, where hatchery-origin fish make up an average of 92% of all returns. The contribution of hatchery programs to the abundance of naturally spawning fish is uncertain, as is their contribution to the productivity of the ESU in total. However, the presence of large numbers of hatchery-origin steelhead in excess of both broodstock needs and available spawning habitat capacity may decrease the productivity of the ESU. With increasing ESU abundance in recent years, naturally spawning, hatchery-origin fish have expanded into unoccupied spawning areas. Collectively, artificial propagation programs benefit ESU abundance and spatial structure but have neutral or uncertain effects on ESU productivity and diversity.

#### 4.3.7.4 Recent Dam Counts and Returns to the Spawning Grounds

Fisher and Hinrichsen's (2004) preliminary estimate of the geometric mean of natural-origin UCR steelhead was 3,643 during 2001-2003, compared to 1,146 in 1996-2000, a 218% increase. The slope of the natural-origin population trend increased 9.2% (from 0.97 to 1.06,) when the data for 2001-2003 were added to the 1990-2000 series, reversing the decline and indicating, at least in the short-term, that the run size has been increasing.

### 4.3.8 MCR Steelhead

#### 4.3.8.1 ESU Structure

The Interior TRT (2003) identified 15 populations in 4 major population groups (Cascades Eastern Slopes Tributaries, John Day River, the Walla Walla and Umatilla Rivers, and the Yakima River) and 1 unaffiliated independent population (Rock Creek) in this ESU (Appendix B, Figure B.8). There are 2 extinct populations in the Cascades Eastern Slope major population group (MPG), the White Salmon and Deschutes Rivers above Pelton Dam.

The MCR steelhead ESU includes all naturally spawned populations of steelhead in streams from above the Wind River in Washington and the Hood River in Oregon (exclusive), upstream to and including the Yakima River in Washington, excluding steelhead from the Snake River Basin (64 FR 14517; March 25, 1999).

NMFS' June 14, 2004, listing proposal did not resolve the ESU membership of native resident populations that are above recent (usually manmade) impassable barriers but below natural barriers. It was provisionally proposed that these resident populations not be considered part of the revised MCR steelhead ESU until such time as significant scientific information becomes available, thereby affording a case-by-case evaluation of their ESU relationships.

#### 4.3.8.2 The BRT Findings

The continued low number of natural returns to the Yakima River (10% of the interim recovery target abundance level, for a subbasin that was a major historical production center for the ESU) generated concern in the BRT. However, steelhead remain well distributed in the majority of subbasins in the ESU. The presence of substantial numbers of out-of-basin (and largely out-of-ESU) natural spawners in the Deschutes River raised substantial concern regarding the genetic integrity and productivity of the native Deschutes population. The extent to which this straying is a historical natural phenomenon is unknown. The cool Deschutes River temperatures may attract fish migrating in the comparatively warm Columbia River, inducing high stray rates. The BRT noted a particular difficulty in evaluating the contribution of resident fish to ESU-level extinction risk. Several sources indicate that resident fish are very common in the ESU and may greatly outnumber anadromous fish. The BRT concluded that the relatively abundant and widely distributed resident fish in the ESU reduce risks to overall ESU abundance but provide an uncertain contribution to ESU productivity, spatial structure, and diversity (NMFS 2003, 2004b).

#### 4.3.8.3 2004 Status Review

In its Status Review, NMFS noted that the abundance of natural populations in the MCR steelhead ESU increased substantially in 2001 over the previous 5 years. The Deschutes and Upper John Day Rivers had recent 5-year mean abundance levels in excess of their respective interim recovery target abundance levels (NMFS 2002). Due to an uncertain proportion of out-of-ESU strays in the Deschutes River, the recent increases in this population were difficult to interpret.

There are seven hatchery steelhead programs considered to be part of the MCR steelhead ESU. These programs propagate steelhead in 3 of 16 ESU populations and improve kelt (post-spawned steelhead) survival in 1 population. There are no artificial programs producing the winter-run life history in the Klickitat River and Fifteenmile Creek populations. All of the ESU hatchery programs are designed to produce fish for harvest, although two are also implemented to augment the naturally spawning populations in the basins where the fish are released.

During the Status Review, NMFS' assessment of the effects of artificial propagation on ESU extinction risk concluded that these hatchery programs collectively do not substantially reduce the extinction risk of the ESU in total (NMFS 2004c). ESU hatchery programs may provide a slight benefit to ESU abundance. Artificial propagation increases total ESU abundance, principally in the Umatilla and Deschutes Rivers. The kelt reconditioning efforts in the Yakima River do not augment natural abundance but do benefit the survival of the natural populations. The Touchet River Hatchery program has only recently been established, and its contribution to ESU viability is uncertain. The contribution of ESU hatchery programs to the productivity of the three target populations and the ESU in total is uncertain. The hatchery programs affect a small proportion of the ESU, providing a negligible contribution to ESU spatial structure. Overall, the impacts to ESU diversity are neutral. Collectively, artificial propagation programs in the ESU provide a slight beneficial effect to ESU abundance but have neutral or uncertain effects on ESU productivity, spatial structure, and diversity.

#### 4.3.8.4 Recent Dam Counts and Returns to the Spawning Grounds

In their preliminary report, Fisher and Hinrichsen (2004) estimated a geometric mean of natural-origin MCR steelhead equal to 17,553 during 2001-2002, compared to 7,228 in 1996-2000, a 143% increase. The slope of the population trend for natural-origin fish increased 6.2% (from 0.99 to 1.05) when the data for 2001-2002 were added to the 1990-2000 series, reversing the decline and indicating that, at least in the short run, the natural-origin population has been increasing.

### 4.3.9 UWR Steelhead

#### 4.3.9.1 ESU Structure

The UWR steelhead ESU includes all naturally spawned populations of winter-run steelhead in the Willamette River in Oregon and its tributaries upstream from Willamette Falls to the Calapooia River (inclusive) (64 FR 14517; March 25, 1999). The W/LC TRT (McElhany et al. 2004) identified four extant, demographically independent populations in one major population group (Appendix B, Figure B.9). NMFS' June 14, 2004, listing proposal did not resolve the ESU membership of native resident populations that are above recent (usually manmade) impassable barriers but below natural barriers. It was provisionally proposed that these resident populations not be considered part of the revised UWR steelhead ESU, until such time as significant scientific information becomes available to afford a case-by-case evaluation of their ESU relationships.

This ESU does not include any artificially propagated *s*teelhead stocks that reside within the historical geographic range of the ESU. Hatchery summer steelhead occur in the Willamette Basin but are an out-of-basin stock that is not included in the ESU.

#### 4.3.9.2 The BRT Findings

The BRT considered the cessation of the "early" winter-run hatchery program a positive sign for ESU diversity risk but remained concerned that releases of non-native summer steelhead continue. Because coastal cutthroat trout are dominant in the basin, resident steelhead are not as abundant or widespread here as in the inland proposed steelhead ESUs. The BRT did not consider resident fish to reduce risks to ESU abundance, and their contribution to ESU productivity, spatial structure, and diversity is uncertain (NMFS 2003, 2004b).

The BRT found moderate risks for each of the VSP categories.

#### 4.3.9.3 2004 Status Review

In its Status Review, NMFS noted that approximately one-third of the LCR steelhead ESU's historically accessible spawning habitat is now blocked. Notwithstanding the lost spawning habitat, the ESU continues to be spatially well distributed, occupying each of the four major subbasins (the Molalla, North Santiam, South Santiam, and Calapooia Rivers). There was some uncertainty about the historical occurrence of steelhead in drainages of the Oregon Coastal Range. Coastal cutthroat trout is a dominant species in the Willamette Basin, and thus steelhead are not expected to have been as widespread in this ESU as they are east of the Cascade Mountains.

#### 4.3.9.4 Recent Dam Counts and Returns to the Spawning Grounds

In their preliminary report, Fisher and Hinrichsen (2004) estimated a geometric mean of natural-origin UWR steelhead at Willamette Falls equal to 9,541 during 2001-2004, compared to 3,961 in 1996-2000, a 141% increase. The slope of the population trend increased 10.4% (from 0.93 to 1.02) when the data for 2001-2004 were added to the 1990-2000 series, reversing the decline and indicating that, at least in the short run, the natural-origin population has been increasing.

### 4.3.10 LCR Steelhead

#### 4.3.10.1 ESU Structure

The LCR steelhead ESU includes all naturally spawned populations of steelhead in streams and tributaries to the Columbia River between the Cowlitz and Wind Rivers in Washington (inclusive) and the Willamette and Hood Rivers in Oregon (inclusive). Excluded are steelhead in the Upper Willamette River Basin above Willamette Falls and steelhead from the Little and Big White Salmon Rivers in Washington (62 FR 43937; August 18, 1997). The W/LC TRT (McElhany et al. 2004) identified a total of 20 extant, demographically independent populations in four major populations groups: Cascade winter-run, Cascade summer-run, Gorge winter-run, and Gorge summer-run in this ESU (Appendix B, Figure B.10).

NMFS' June 14, 2004, listing proposal did not resolve the ESU membership of native resident populations that are above recent (usually manmade) impassable barriers but below natural barriers. It was provisionally proposed that these resident populations not be considered part of the revised LCR steelhead ESU until such time as significant scientific information becomes available to afford a case-by-case evaluation of their ESU relationships. The presence of four major population groups in this ESU makes it is less likely that any single group is significant for this ESU's survival and recovery, compared to ESUs with fewer major population groups.

#### 4.3.10.2 The BRT Findings

Approximately 35% of historical habitat has been lost in this ESU due to the construction of dams or other impassible barriers, but the ESU exhibits a broad spatial distribution in a variety of watersheds and habitat types. The BRT was particularly concerned about the impact on ESU diversity of the high proportion of hatchery-origin spawners in the ESU, the disproportionate declines in the summer steelhead life history, and the release of nonnative hatchery summer steelhead in the Cowlitz, Toutle, Sandy, Lewis, Elochoman, Kalama, Wind, and Clackamas Rivers. Resident fish are not as abundant in this ESU as they are in the proposed steelhead ESUs. The BRT did not consider resident fish to reduce risks to ESU abundance, and their contribution to ESU productivity, spatial structure, and diversity is uncertain (NMFS 2003, 2004b).

The BRT found moderate risks in each of the VSP categories.

#### 4.3.10.3 2004 Status Review

In its Status Review, NMFS noted that some anadromous populations in the LCR steelhead ESU, particularly summer-run steelhead populations, had shown encouraging increases in abundance in the 2 to 3 years ending 2001. However, population abundance levels remained small (no population had a recent 5-year mean abundance greater than 750 spawners).

There are 10 artificial propagation programs releasing hatchery steelhead that are considered to be part of the LCR steelhead ESU. All of these programs are designed to produce fish for harvest, but several are also implemented to augment the natural spawning populations in the basins where the fish are released. Four of these programs are part of research activities to determine the effects of artificial propagation programs that use naturally produced steelhead for broodstock in an attempt to minimize the genetic effects of returning hatchery adults that spawn naturally. One of these programs, the Cowlitz River late-run winter steelhead program, is also producing fish for release into the Upper Cowlitz River Basin in an attempt to reestablish a natural spawning population above Cowlitz Falls Dam.

NMFS concluded that these hatchery programs collectively do not substantially reduce the extinction risk of the ESU in total (NMFS 2004c). The hatchery programs have reduced risks to ESU abundance by increasing total ESU abundance and the abundance of fish spawning naturally in the ESU. The contribution of ESU hatchery programs to the productivity of the ESU in total is uncertain. It is also uncertain if steelhead reintroduced into the Upper Cowlitz River will be viable in the foreseeable future, because outmigrant survival appears to be quite low. As noted by the BRT, out-of-ESU hatchery programs have negatively impacted ESU productivity. The within-ESU hatchery programs provide a slight decrease in risks to ESU spatial structure, principally through the re-introduction of steelhead into the Upper Cowlitz River Basin. The eventual success of these reintroduction efforts, however, is uncertain. Collectively, artificial propagation programs in the ESU provide a slight beneficial effect on ESU abundance, spatial structure, and diversity but uncertain effects on ESU productivity.

#### 4.3.10.4 Recent Dam Counts and Returns to the Spawning Grounds

In their preliminary report, Fisher and Hinrichsen (2004) estimated that the aggregate abundance of LCR steelhead was equal to 4,429 during 2001, compared to 6,333 during the period 1996-2000, a 30% decrease in abundance. The slope of the aggregate population trend declined by 0.8% (from 0.93 to 0.92) when the 2001 count was added to the 1990-2000 data series.

### 4.3.11 CR Chum Salmon

#### 4.3.11.1 ESU Structure

The W/LC TRT (McElhany et al. 2004) identified a total of 8 extant, demographically independent populations in three major population groups in this ESU: Coastal, Cascade, and Gorge (Appendix B, Figure B.11). Approximately 90% of the historical populations in the Columbia River chum ESU are extirpated or nearly so, and the Gorge population group was established by inferring that the approximately 100 adult chum salmon that ascend the

Bonneville Dam fish ladders each year are spawning upstream. However, the Washington Department of Fish and Wildlife (WDFW) found only one and two carcasses in its 2002 and 2003 spawning ground surveys in the Gorge area, respectively, and its radio-tag data indicate that at least some fish fall back downstream (Ehlke and Keller 2003). The Smolt Monitoring Program has no record of juvenile chum salmon at Bonneville Dam.

#### 4.3.11.2 The BRT Findings

The loss of off-channel habitats and the extirpation of approximately 17 historical populations increase the ESU's vulnerability to environmental variability and catastrophic events. The populations that remain are low in abundance and have limited distribution and poor connectivity. The BRT found high risks for each of the VSP categories, particularly for the ESU's spatial structure and diversity.

#### 4.3.11.3 2004 Status Review

In its Status Review, NMFS noted that approximately 90% of the historical populations in the CR chum salmon ESU are extirpated or nearly so. During the 1980s and 1990s, the combined abundance of natural spawners for the Lower and Upper Columbia River Gorge, Washougal, and Grays River populations was below 4,000 adults. In 2002, however, the abundance of natural spawners exhibited a substantial increase at several locations. The preliminary estimate of natural spawners in 2002 was approximately 20,000 adults. The cause of this dramatic increase in abundance is unknown. Improved ocean conditions, the initiation of a supplementation program the Grays River, improved flow management at Bonneville Dam, favorable freshwater conditions, and increased survey sampling effort may have contributed to the elevated 2002 abundance. However, long- and short-term productivity trends for ESU populations were at or below replacement. The loss of off-channel habitats and the extirpation of approximately 17 historical populations increase the ESU's vulnerability to environmental variability and catastrophic events. The populations that remain are low in abundance, have limited distribution and poor connectivity.

There are three artificial propagation programs producing chum salmon considered to be part of the Columbia River chum salmon ESU. These are conservation programs designed to support natural productivity. The Washougal Hatchery artificial propagation program provides artificially propagated chum salmon for reintroduction into recently restored habitat in Duncan Creek, Washington. This program also provides a safety net for the naturally spawning population in the mainstem Columbia River below Bonneville Dam. That population can access only a portion of spawning habitat during low-flow conditions. The other two programs are designed to augment natural production in the Grays River and the Chinook River in Washington. All these programs use naturally produced adults for broodstock. These programs were only recently established (1998-2002), with the first hatchery chum salmon returning in 2002.

NMFS' assessment of the effects of artificial propagation on ESU extinction risk concluded that these hatchery programs collectively do not substantially reduce the extinction risk of the ESU in total (NMFS 2004c). They have only recently been initiated and are just beginning to provide benefits to ESU abundance. The contribution of ESU hatchery programs to the productivity of the ESU in total is uncertain. The Sea Resources and Washougal Hatchery programs have begun to provide benefits to ESU spatial structure through reintroductions of chum salmon into restored habitats in the Chinook River and Duncan Creek, respectively. These three programs have a neutral effect on ESU diversity. Collectively, artificial propagation programs in the ESU provide a slight beneficial effect to ESU abundance and spatial structure but have neutral or uncertain effects on ESU productivity and diversity.

#### 4.3.11.4 Recent Returns to the Spawning Grounds

In their preliminary report, Fisher and Hinrichsen (2004) estimated a geometric mean of the aggregate number of CR chum salmon in two index areas (Grays River and Hamilton and Hardy Creeks) equal to 1,776 during 2001-2003, compared to 2,114 in 1996-2000, a 16% decrease. The slope of the aggregate population trend decreased 1.5% (from 1.02 to 1.00) when the data for 2001-2003 were added to the 1990-2000 series.

### 4.3.12 SR Sockeye Salmon

#### 4.3.12.1 ESU Structure

Anadromous sockeye salmon were once abundant in a variety of lakes throughout the Snake River Basin, including the Alturas, Pettit, Redfish, Stanley, and Yellowbelly Lakes in the Sawtooth Valley and in Wallowa, Payette, and Warm Lakes (Appendix B, Figure B.12), but the only remaining population resides in Redfish Lake. Beginning in the late nineteenth century, anadromous sockeye salmon were affected by heavy harvest pressures, unscreened irrigation diversions, and dam construction (TRT 2003). In addition, in the 1950s and 1960s, the Idaho Department of Fish and Game (IDFG) actively eradicated sockeye salmon from some locations.

The SR sockeye salmon ESU includes populations of anadromous sockeye salmon from the Snake River Basin in Idaho, though extant populations occur only in the Stanley Basin (56 FR 58619; November 20, 1991). The ESU also includes residual sockeye salmon in Idaho's Redfish Lake, as well as one captive propagation hatchery program. Artificially propagated sockeye salmon from the Redfish Lake Captive Broodstock Program are considered part of this ESU. NMFS has determined that this artificially propagated stock is genetically no more than moderately divergent from the natural population (NMFS 2004c). Subsequent to the 1991 listing determination for SR sockeye salmon, a "residual" form of Snake River sockeye salmon (hereinafter residuals) was identified. The residuals often occur together with anadromous sockeye salmon and exhibit similar behavior in the timing and location of spawning. Residuals are thought to be the progeny of anadromous sockeye salmon but are generally non-anadromous. In 1993, NMFS determined that the residual population of Snake River sockeye salmon that exists in Redfish Lake is substantially reproductively isolated from kokanee (i.e., non-anadromous populations of *O. nerka* that become resident in lake environments over long periods of time), represents an important component in the evolutionary legacy of the biological species, and thus merits inclusion in the SR sockeye salmon ESU.

Only 16 naturally produced adults have returned to Redfish Lake since the Snake River sockeye salmon ESU was listed as an endangered species in 1991. All 16 fish were taken into the

Redfish Lake Captive Broodstock Program, which was initiated as an emergency measure in 1991. The return of over 250 adults in 2000 was encouraging; however, subsequent returns from the captive program in 2001 and 2002 have been fewer than 30 fish. The BRT found extremely high risks for all four VSP categories.

#### 4.3.12.2 The BRT Findings and the 2004 Status Review

There is a single artificial propagation program producing SR sockeye salmon in the Snake River Basin. The Redfish Lake sockeye salmon stock was originally founded by collecting the entire anadromous adult return of 16 fish between 1990 and 1997, the collection of a small number of residual sockeye salmon, and the collection of a few hundred smolts migrating from Redfish Lake. These fish were put into a Captive Broodstock program as an emergency measure to prevent extinction of this ESU. Since 1997, nearly 400 hatchery-origin anadromous sockeye salmon adults have returned to the Stanley Basin from juveniles released by the program. Redfish Lake sockeye salmon have also been reintroduced into Alturas and Pettit Lakes using progeny from the captive broodstock program. The captive broodstock program presently consists of several hundred fish of different year classes maintained at facilities in Eagle, Idaho, and Manchester, Washington.

NMFS' assessment of the effects of artificial propagation on ESU extinction risk concluded that the Redfish Lake Captive Broodstock Program does not substantially reduce the extinction risk of the ESU in total (NMFS 2004c). The Artificial Propagation Evaluation Workshop noted that the Redfish Lake Captive Broodstock Program has likely prevented extinction of the ESU. This program has increased the total number of anadromous adults, attempted to increase the number of lakes in which sockeye salmon are present in the Upper Salmon River (Stanley Basin), and preserved what genetic diversity remains in the ESU. Although the program has increased the number of anadromous adults in some years, it has yet to produce consistent returns, and the long-term effects of captive rearing are unknown. The consideration of artificial propagation does not substantially mitigate the BRT's assessment of extreme risks to ESU abundance, productivity, spatial structure, and diversity.

#### 4.3.12.3 Recent Dam Counts and Returns to the Spawning Grounds

In their preliminary report, Fisher and Hinrichsen (2004) estimated a geometric mean of aggregate numbers of SR sockeye salmon equal to 14 during 2001-2004 compared to 4 in 1996-2000, a 211% increase. However, because returns were higher in 2001 and 2002 than in 2003, the slope of the aggregate population trend decreased 3.7% (from 1.26 to 1.22) when the data for 2001-2004 were added to the 1990-2000 series.

### 4.3.13 LCR Coho Salmon

#### 4.3.13.1 ESU Structure

The W/LC TRT (McElhany et al. 2004) identified a total of 21 extant, demographically independent populations in three major population groups in this ESU: Coastal, Cascade, and Gorge (Appendix B, Figure B-13). There are only 2 extant populations in the LCR coho salmon

ESU with appreciable natural productivity, the Clackamas and Sandy River populations, down from an estimated 23 historical populations in the ESU.

#### 4.3.13.2 The BRT Findings

Short- and long-term trends in productivity are below replacement. Approximately 40% of historical habitat is currently inaccessible, which restricts the number of areas that might support natural productivity and further increases the ESU's vulnerability to environmental variability and catastrophic events. The extreme loss of naturally spawning populations, the low abundance of extant populations, diminished diversity, and fragmentation and isolation of the remaining naturally produced fish confer considerable risks on the ESU. The lack of naturally produced spawners in this ESU is contrasted by the very large number of hatchery-produced adults. The abundance of hatchery coho salmon returning to the Lower Columbia River in 2001 and 2002 exceeded 1 million and 600,000 fish, respectively. The BRT expressed concern that the magnitude of hatchery production continues to pose significant genetic and ecological threats to the extant natural populations in the ESU. However, these hatchery stocks collectively represent a significant portion of the ESU's remaining genetic resources. The 21 hatchery stocks considered to be part of the ESU, if appropriately managed, may prove essential to the restoration of more widespread naturally spawning populations. The BRT found extremely high risks for all VSP categories.

#### 4.3.13.3 2004 Status Review

There are only 2 extant populations in the LCR coho salmon ESU with appreciable natural production (the Clackamas and Sandy River populations), from an estimated 23 historical populations in the ESU. Although adult returns in 2000 and 2001 for the Clackamas and Sandy River populations exhibited moderate increases, the recent 5-year mean of natural-origin spawners for both populations represented less than 1,500 adults. The Sandy River population had exhibited recruitment failure in 5 of 10 years (i.e., 1992-2001), and had exhibited a poor response to reductions in harvest. During the 1980s and 1990s, natural spawners were not observed in lower basin tributaries. Coincident with the 2000–2001 abundance increases in the Sandy and Clackamas populations, a small number of coho salmon spawners of unknown origin have been surveyed in some of these areas. Short- and long-term trends in productivity are below replacement.

Approximately 40% of historical habitat is currently inaccessible, which restricts the number of areas that might support natural production, and further increases the ESU's vulnerability to environmental variability and catastrophic events. The extreme loss of naturally spawning populations, the low abundance of extant populations, diminished diversity, fragmentation, and isolation of the remaining naturally produced fish confer considerable risks. The paucity of natural-origin spawners is contrasted by the very large number of hatchery-produced adults. The numbers of hatchery coho salmon returning to the lower Columbia River in 2001 and 2002 exceeded 1 million and 600,000 fish, respectively.

All of the 21 hatchery programs included in the LCR coho salmon ESU are designed to produce fish for harvest, and 2 of the smaller programs are also designed to augment the natural spawning populations in the Lewis River Basin. Artificial propagation in this ESU continues to represent a threat to the genetic, ecological, and behavioral diversity of the ESU. Past artificial propagation efforts imported out-of-ESU fish for broodstock, generally did not mark hatchery fish, mixed broodstocks derived from different local populations, and transplanted stocks among basins throughout the ESU. The result is that the hatchery stocks considered to be part of the ESU represent a homogenization of populations. Several of these risks have recently begun to be addressed by improvements in hatchery practices. Out-of-ESU broodstock is no longer used, and near 100% marking of hatchery fish is employed to improve monitoring and evaluation of broodstock and (hatchery- and natural-origin) returns. However, many of the within-ESU hatchery programs do not adhere to best hatchery practices. Eggs are often transferred among basins in an effort to meet individual program goals, further compromising ESU spatial structure and diversity. Programs may use broodstock that does not reflect what was historically present in a given basin, limiting the potential for artificial propagation to establish locally adapted naturally spawning populations. Many programs lack Hatchery and Genetic Management Plans (HGMPs) that establish escapement goals appropriate for the natural capacity of each basin and that identify goals for the incorporation of natural-origin fish into the broodstock.

During the Status Review, NMFS' assessment of the effects of artificial propagation on ESU extinction risk concluded that hatchery programs collectively mitigate the immediacy of extinction risk for the LCR coho salmon ESU in total in the short-term, but these programs do not substantially reduce the extinction risk of the ESU in the foreseeable future (NMFS 2004c). At present, within-ESU hatchery programs significantly increase the abundance of the ESU in total. Without adequate long-term monitoring, the contribution of ESU hatchery programs to the productivity of the ESU in total is uncertain. The hatchery programs are widely distributed throughout the Lower Columbia River, reducing the spatial distribution of risk from catastrophic events.

Additionally, reintroduction programs in the Upper Cowlitz River may provide additional reduction of ESU spatial structure risks. As mentioned above, the majority of the ESU's genetic diversity exists in the hatchery programs. Although these programs have the potential of preserving historical local adaptation and behavioral and ecological diversity, the manner in which these potential genetic resources are presently being managed poses significant risks to the diversity of the ESU in total. At present, the LCR coho salmon hatchery programs reduce risks to ESU abundance and spatial structure, provide uncertain benefits to ESU productivity, and pose risks to ESU diversity. Overall, artificial propagation mitigates the immediacy of ESU extinction risk in the short-term but is of uncertain contribution in the long-term.

Over the long-term, reliance on the continued operation of these hatchery programs is risky (NMFS 2004c). Several LCR coho salmon hatchery programs have been terminated, and there is the prospect of additional closures in the future. With each hatchery closure, any potential benefits to ESU abundance and spatial structure are reduced. Risks of operational failure, disease, and environmental catastrophes further complicate assessments of hatchery contributions over the long-term. Additionally, the two extant naturally spawning populations in the ESU were described by the BRT as being "in danger of extinction." Accordingly, it is likely that the LCR coho salmon ESU may exist in hatcheries only within the foreseeable future. It is uncertain whether these isolated hatchery programs can persist without the incorporation of natural-origin fish into the broodstock. Although there are examples of salmonid hatchery programs having been in operation for relatively long periods of time, these programs have not existed in complete isolation. Long-lived hatchery programs historically required infusions of wild fish in order to meet broodstock goals. The long-term sustainability of such isolated hatchery programs is unknown. It is uncertain whether the LCR coho salmon isolated hatchery programs are capable of mitigating risks to ESU abundance and productivity into the foreseeable future. In isolation, these programs may also become more than moderately diverged from the evolutionary legacy of the ESU and hence no longer merit inclusion in the ESU. Under either circumstance, the ability of artificial propagation to buffer the immediacy of extinction risk over the long-term is uncertain.

#### 4.3.13.4 Recent Dam Counts and Returns to the Spawning Grounds

In their preliminary report, Fisher and Hinrichsen (2004) estimated a geometric mean of aggregate numbers of LCR coho salmon equal to 3,027 during 2001-2003, compared to 822 in 1996-2000, a 268% increase. The slope of the aggregate population trend increased 10.4% (from 0.92 to 1.02) when the data for 2001-2003 were added to the 1990-2000 series, reversing the decline and indicating that, at least in the short run, the aggregate run is increasing.

# 5. ENVIRONMENTAL BASELINE

## 5.1 Overview

The environmental baseline is defined as "the past and present impacts of all Federal, State, or private actions and other human activities in the action area, including the anticipated impacts of all proposed Federal projects in the action area that have undergone Section 7 consultation and the impacts of State and private actions that are contemporaneous with the consultation in progress" (50 CFR 402.02, "effects of the action," emphasis added). It is an analysis of "the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat and ecosystem, within the action area," including designated critical habitat. "It does not include the effects of the action under review" (ESA Section 7 Consultation Handbook [March 1998] p. 4-22, emphasis added).

When the consultation is for an ongoing action, the task of assessing the effects of the environmental baseline is complicated by the fact that certain preexisting aspects of the ongoing project are also part of the environmental baseline, while other proposed aspects represent the proposed action that is the subject of the consultation. It is important to recognize a fundamental principle of an ESA Section 7(a)(2) consultation. Section 402.03 provides: "Section 7 and the requirements of this part apply to all actions in which there is discretionary involvement or control." Accordingly, the ESA requires a Federal agency to consult on actions that it proposes to authorize, fund, or carry out pursuant to its discretionary authority (see also 50 CFR 402.02 "action" and ESA Section 7(a)(2)). Thus, it follows that the ESA does not require consultation on any elements of the preexisting project that are beyond the agency's current discretion or control, i.e., anything that is part of the environmental baseline. In addition, the continuing effects of those aspects of USBR's projects that are not subject to USBR discretion, such as their existence and operations necessary to satisfy Congressionally mandated purposes, are considered part of the environmental baseline. Irrigation is a Congressionally-mandated project purpose for all of USBR's projects in the Upper Snake River Basin. Additionally, some projects are authorized by Congress for flood control, power generation, some limited recreation, and fish and wildlife purposes. It is difficult to distinguish between those effects associated with discretionary project operations versus non-discretionary operations. Therefore, in order to simplify and take a conservative approach to the analysis, the effects associated with both discretionary and non-discretionary USBR project operations are considered in this consultation.

The effects of the projects that must be considered as part of the environmental baseline are a subset of all environmental baseline effects in the action area. The continuing effects of the projects' past construction and operation must be considered with the effects of past or present actions and other human activities affecting the species and their habitat within the action area.

Environmental baseline effects are evaluated in relation to the biological requirements of the listed species. The ESUs differ in how they use habitat in the action area, but all rely on this habitat during one or more stages in the life-cycle. Habitat uses include adult holding, spawning, incubation, rearing, and migration. The biological requirements of the species include conditions sufficient to satisfy these uses, thus contributing to the survival and recovery of the ESUs to naturally reproducing and self-sustaining populations. Sections 5.4.1 through 5.4.13 review the status of habitat and other factors within the action area that affect viability for each ESU. If critical habitat would be affected, NMFS reviews the environmental baseline conditions of essential features: substrate, water quality, water quantity, water temperature, water velocity, cover/shelter, food (primarily for juveniles), riparian vegetation, space, and safe passage conditions.

### 5.1.1 Action Area

The action area for an ESA consultation is described by NMFS' and the USFWS's joint implementing regulations (50 CFR 402.02) to mean "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The action area is not delineated by the migratory range of the species affected by the project unless that area is also directly or indirectly affected by the proposed actions. Thus NMFS defines the action area for this consultation as:

- Henrys Lake and the Henrys Fork from Henrys Lake downstream to its confluence with the Snake River (Henrys Lake is not part of the proposed action, but its operations are coordinated with USBR facilities).
- Cascade Creek downstream from Cascade Creek Diversion Dam to its confluence with Grassy Creek.
- Grassy Lake and Grassy Creek from Grassy Lake Dam downstream to its confluence with the Falls River, and the Falls River downstream to its confluence with the Henrys Fork.
- Ririe Reservoir and Willow Creek from Ririe Dam to its confluence with the Snake River.
- Jackson Lake.
- Little Wood River Reservoir and the Little Wood River from the Little Wood River Dam downstream to its confluence with the Snake River.
- Owyhee Reservoir and the Owyhee River from Owyhee Dam downstream to its confluence with the Snake River.
- Anderson Ranch Reservoir and the South Fork Boise River from Anderson Ranch Dam downstream to its confluence with the Boise River.
- Arrowrock Reservoir and the Boise River from Arrowrock Reservoir downstream to its confluence with the Snake River.
- Lake Lowell.
- Payette Lake and the North Fork Payette River from Payette Lake downstream to its confluence with the Payette River, including Lake Cascade (Payette Lake is not a part of the proposed action, but its operations are coordinated with USBR facilities).

- Deadwood Reservoir and the Deadwood River from Deadwood Dam downstream to its confluence with the South Fork Payette River.
- The South Fork Payette River from its confluence with the Deadwood River downstream to its confluence with the North Fork Payette River.
- The Payette River from its confluence with the North Fork Payette River and South Fork Payette River downstream to its confluence with the Snake River.
- Beulah Reservoir and the North Fork Malheur River downstream from Agency Valley Dam to its confluence with the Malheur River.
- Bully Creek Reservoir and Bully Creek downstream from Bully Creek Diversion Dam to its confluence with the Malheur River.
- Warm Springs Reservoir and the Malheur River downstream from Warm Springs Dam to its confluence with the Snake River.
- Mann Creek Reservoir and Mann Creek downstream from Mann Creek Dam to its confluence with the Weiser River
- The Weiser River from its confluence with Mann Creek downstream to its confluence with the Snake River.
- Unity Reservoir and the Burnt River from Unity Dam downstream to its confluence with the Snake River.
- Phillips Lake and the Powder River downstream from Mason Dam to its confluence with the Snake River.
- Thief Valley Reservoir and the Powder River downstream from Thief Valley Dam to its confluence with the Snake River.
- All land over which USBR project water flows until it is consumed or returned to the mainstem Snake River.
- The mainstem Snake River from Jackson Lake downstream to its confluence with the Columbia River.
- The mainstem Columbia River from its confluence with the Snake River to the Columbia River estuary and plume (i.e., nearshore ocean).
- The estuary and nearshore environment affected by water management operations, including the area between the upstream limit of tidal influence at Bonneville Dam (about RM 146), the mouth of the Columbia River, and the ocean plume.

The action area for this consultation is shown in Figure 5-1.

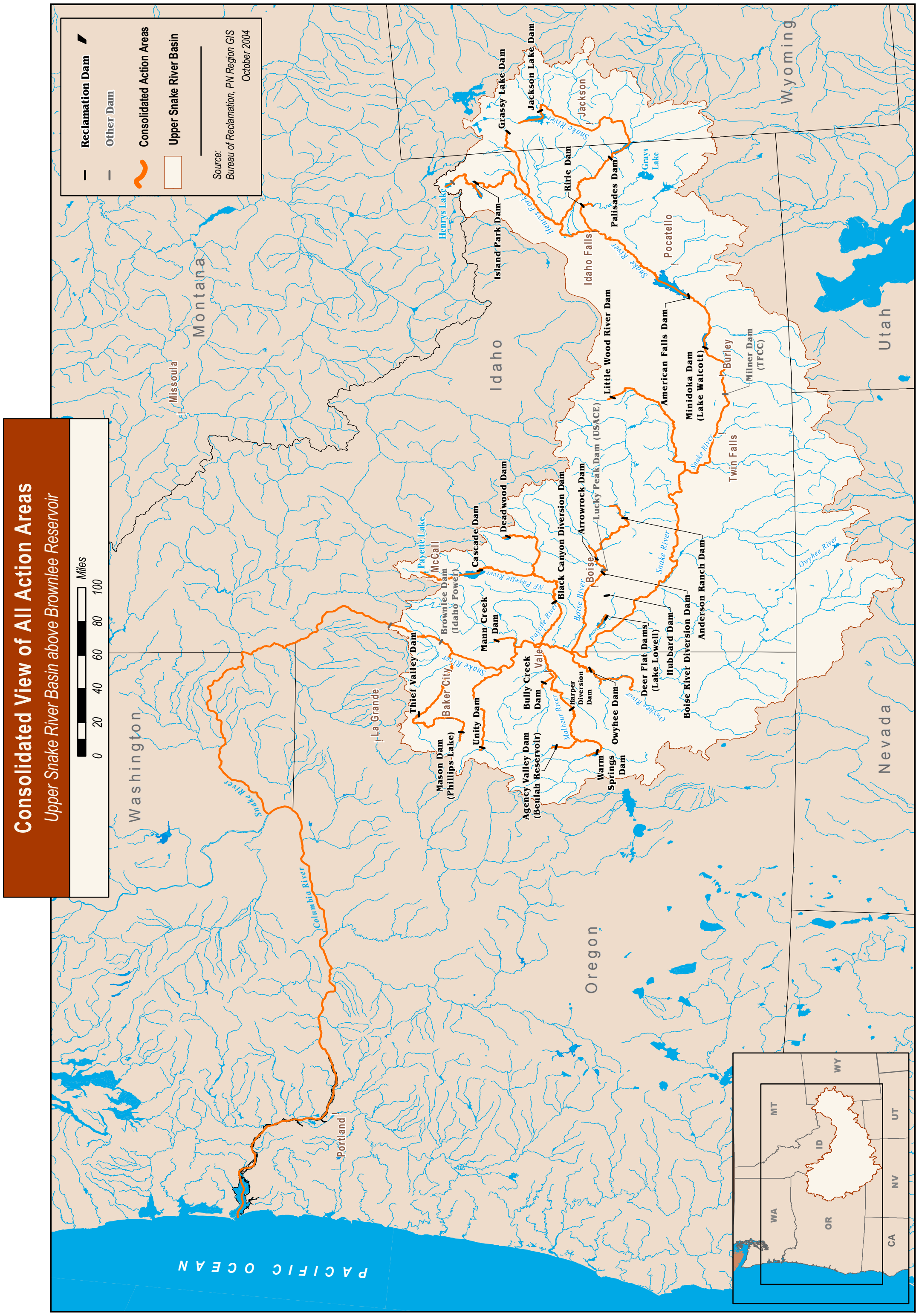
### 5.1.2 Biological Requirements and Essential Habitat Features within the Action Area

Biological requirements can be expressed as those habitat conditions or survival rates within the action area that support a sufficient number and distribution of viable populations (i.e., populations with adequate abundance, productivity, spatial structure, and diversity) necessary for the survival and recovery of the ESU. The factors that directly influence the viability of a population, and thus are relevant for NMFS' assessment of its status within the portion of the action area that is occupied by listed species, are the habitat conditions and survival rates associated with properly functioning salmonid habitat. For designated critical habitat, they are the essential physical and biological features. NMFS expects to refine its assessment of biological requirements necessary for survival and recovery in the course of recovery planning. Until recovery plans are adopted, NMFS' assessment of biological requirements is conservative.

For three ESUs of SR salmon,[15] the essential features of designated critical habitat are substrate, water quality, water quantity, water temperature, food, riparian vegetation, access, water, velocity, space, and safe passage. These features also describe the habitat factors associated with viability for all ESUs. The specific habitat requirements for each ESU differ by life history type and life stage. These are described in more detail for each of these three ESUs in Sections 5.4.1 through 5.4.13.

[15]SR spring/summer chinook salmon, SR fall chinook salmon, and SR sockeye salmon have designated critical habitat.

**Figure 5-1.** The action area for this consultation.



The survival rates associated with properly functioning habitat conditions also define some features of the species' biological requirements. In most cases, the specific survival rates associated with properly functioning conditions cannot be quantified for a specific reach. However, general approximations of juvenile and adult survival rates through the migratory corridor without the effects of the FCRPS have been developed (2004 FCRPS Biological Opinion [NMFS 2004a] Section 5.2.2.3.1.2). These are compared to the estimated juvenile survivals rates under the environmental baseline.

In general, the closer the action area habitat conditions and survival rates are to those under which the species evolved, the more likely it is that the biological requirements are being met. For this reason, Sections 5.2 and 5.3 review the current habitat features of the action area in the context of historical conditions. Biological requirements can be defined more specifically for some habitat features than others. For example, a TDG concentration of no more than 120% of saturation is a biological requirement of juveniles and adults migrating through the FCRPS, as described in Section 5.3.3.2. Biological requirements for space are more difficult to define.

### 5.1.3 Factors Affecting the Species' Biological Requirements Outside of the Action Area

The status of each species considered in this Opinion is affected by a broad array of environmental conditions outside of the action area. These conditions include tributary habitat conditions, hatchery operations, and harvest in areas outside of the action area. These factors affect the species' range-wide status and are discussed in Section 4.

## 5.2 Federal Facilities and Operations in the Environmental Baseline

All Federal actions within the action area or which affect the biological requirements of the species within the action area for which Section 7 consultations have been completed are part of the environmental baseline. Also, existing Congressionally authorized facilities within the action area, or which affect the biological requirements of the species within the action area, are part of the environmental baseline, provided their continued existence is beyond the management agency's discretion. Such Federal facilities are described below.

### 5.2.1 FCRPS Projects in the Migratory Corridor

A primary consideration in this Opinion is the PA's effects on listed fish habitat conditions within the currently occupied migratory corridor (i.e., from Hells Canyon Dam to the Columbia River plume) and how those habitat effects would influence fish survival. Habitat characteristics within the migratory corridor are strongly influenced by the configuration and operation of the series of Federal hydropower projects located on the mainstem Snake and Columbia Rivers. These facilities are (from upstream to downstream):

- Lower Granite Dam and Reservoir
- Little Goose Dam and Reservoir
- Lower Monumental Dam and Reservoir
- Ice Harbor Dam and Reservoir
- McNary Dam and Reservoir

- John Day Dam and Reservoir
- The Dalles Dam and Reservoir
- Bonneville Dam and Reservoir

These facilities are all part of the FCRPS. On November 30, 2004, the Federal Action Agencies and NMFS completed a new consultation on the continued operation and maintenance of the FCRPS projects with NMFS' issuance of a biological opinion (NMFS 2004a), which was followed by Action Agency issuance of Records of Decision (Corps 2004; BPA 2004; USBR 2004). The environmental baseline considered in this Opinion includes the effect from both the current and anticipated future operations and configurations of the FCRPS facilities as described in the Updated Proposed Action for that consultation (Corps et al. 2004).

### 5.2.2 USBR Facilities and Operations in the Environmental Baseline

As discussed above, all of the USBR facilities under consultation in this Opinion already exist, and their existence is beyond the scope of the present discretion of USBR to reverse. Conversely, many aspects of the water management at the dams are within the USBR's scope of discretion, and thus the effects of that management are attributable to the proposed action. Beyond these obvious conclusions, however, it is difficult to distinguish between the effects associated with discretionary project operations and those associated with non-discretionary operations.

Similar to their lack of authority to significantly modify existing structures, the USBR does not have the discretion to wholly abandon some operations. Flood control and irrigation are examples of Congressionally authorized USBR project purposes, as is some level of power generation. USBR is required by Congress to meet its non-discretionary obligation to deliver water for irrigation, but precisely how to operate the projects to provide irrigation water is discretionary. Although USBR is obligated to operate its facilities to provide water for irrigated agriculture, for the purpose of this consultation the USBR has chosen to consult on both the discretionary and non-discretionary components of its project operations. This conservative approach avoids the potential that a portion of project operations considered non-discretionary in this Opinion will subsequently be found to be discretionary, and thus subject to further ESA consultation.

Therefore, for purposes of this consultation, NMFS, with the assistance of the USBR, developed a "reference operation" that serves as a conservative surrogate for the environmental baseline operation (Section 5.2.2.1). The reference operation is a theoretical hydrologic simulation that estimates the hydrologic conditions in the mainstem Snake and Columbia Rivers without the operation of the USBR's Upper Snake projects. NMFS uses this theoretical reference operation as a tool to estimate fish survival through the action area under the environmental baseline. This reference or "baseline" level of survival is then compared to the level associated with the proposed action to determine its effects. It is important to recognize, however, that the reference operation serves only as a point of reference for measuring effects of the PA; that is, the difference between the two operations overestimates the potential effects caused by the USBR's exercise of discretion to achieve all authorized project purposes. By eliminating the hydrologic effects of all project operations, the reference operation is a theoretical operation that the USBR could not implement, because it fails to meet all the authorized purposes of the projects. However, this conservative approach to defining the reference operation allows the consultation to move forward without having to go through the process of trying to precisely determine the extent of USBR's discretionary operations.

### 5.2.2.1 The Reference Operation

The USBR completed a simulation study to analyze a "Without Projects Operations" scenario; this scenario isolates the flow effects at Brownlee Reservoir that are attributable to the combined effects of storing and releasing project water from USBR's reservoirs, of diverting project water at downstream points of delivery, and of return flows. Larson (2005) more fully describes this simulation study. This scenario simulates the hydrologic conditions that would occur if the USBR's facilities were in place but not operating to store and divert water for agriculture or flood control,[16] and with all non-Federal water withdrawals of natural flow continuing. This simulation is a theoretical scenario that makes no assumptions as to how water users would have reacted had the USBR not built the dams, headworks, canals, or secured natural flow water rights.

Table 5-1 shows the USBR's reservoirs and associated storage contracts removed from the Current Operations model data sets to develop a "Without Projects Operations" scenario. USBR's space assignments in Henrys Lake and Blackfoot Reservoir were assumed to remain as in the Current Operations data set. All operational target flow objectives (such as flood control or minimum flows) were removed. With the exception of privately held natural flow water rights, diversions to USBR facilities were shut off. Table 5-1 also summarizes USBR diversions that were removed from the Current Operations data set. These include all diversions of Federal project water. Gains to the Snake River above King Hill associated with USBR activities were adjusted using response functions from the Eastern Snake Plain Aquifer (ESPA) regional groundwater model (Johnson et al. 1998; Johnson and Cosgrove 1999 in Larson 2003). Adjustments to the gains in the Boise, the Payette, the mainstem of the Snake River downstream of King Hill, and the Owyhee River Basins were made using estimated water budgets to derive "return flow factors" (Larson 2003).

[16] Removing the USBR's dam operations means that rivers would run through empty reservoirs and project water is not stored or diverted.

**Table 5-1** Federal storage and diversion facilities and associated actions to develop a "Without Projects Operations" scenario.[1] Source: USBR 2004.

| Storage Facility | Action |
|---|---|
| Jackson Lake Dam | Removed |
| Grassy lake Dam | Removed |
| Island Park Dam | Removed |
| American falls Dam | Removed |
| Minidoka Dam | Removed |
| Palisades Dam | Removed |
| Ririe Dam | Removed |
| Little Wood River Dam | Removed |
| Owyhee Dam | Removed |
| Anderson Ranch Dam | Removed |
| Arrowrock Dam | Removed |
| Lucky Peak Dam | Removed |
| Deadwood Dam | Removed |
| Cascade Dam | Removed |
| Hubbard Dam | Not modeled |
| Deer Flats Dam | Removed |

| Diversion Facility | Action |
|---|---|
| Cascade Creek Diversion Dam | Not modeled |
| Minidoka Northside Headworks | Diverts 40% of natural flow right |
| Minidoka Southside Headworks | Diverts 40% of natural flow right |
| Unit A Pumping Plant | Removed |
| Milner-Gooding Canal Headworks | Removed |
| falls Irrigation Pumping Plant | Removed |
| Tunnel No. 1 | Removed |
| Dead Ox Pumping Plant | Removed |
| Ontario-Nyssa Pumping Plant | Removed |
| Gem Pumping Plants #1 and #2 | Diverts private natural flow only |
| Boise River Diversion Dam | Diverts private natural flow only |
| | |
| | |
| | |
| Black Canyon Diversion Dam | Diverts private natural flow only |

1 Project facilities and operations associated with the Vale, Mann Creek, Burnt River, and Baker Projects were not included in the Upper Snake River MODSIM model and therefore are not modeled in the "Without Projects Operations" simulation. Storage facilities associated with these projects include Warm Springs, Agency Valley, Bully Creek, Mann Creek, Unity, Mason, and Thief Valley Dams. Diversion facilities associated with these projects include Harper Diversion Dam, Bully Creek Diversion Dam, Mann Creek Dam Outlet, and Savely Dam and Lilley Pumping Plant.

## 5.3 Factors Affecting Salmon and Steelhead Survival in the Action Area

An array of factors influences salmon and steelhead survival in the action area. These factors include dam and reservoir passage conditions at the eight FCRPS mainstem dams, hydrologic conditions, water quality conditions, predation, disease, artificial propagation programs, and harvest. The PA under consideration in this Opinion directly and indirectly affects hydrologic conditions in the action area. Changes in hydrologic conditions can affect dam and reservoir passage survival, water quality conditions (primarily water temperature), and disease and predation rates (by its influence on water temperature).

### 5.3.1 Baseline Physical Habitat Conditions in the Action Area

The Columbia River is a dynamic system. It has been affected and shaped over eons by a variety of natural forces, including volcanic activity, storms, floods, natural events, and climate changes. These forces had, and continue to have, a significant influence on biological factors, habitat, inhabitants, and the whole riverine and estuarine environment of the Columbia River.

The Snake River and lower Columbia River and estuary habitats have been affected over the past 60 years by the existence and operation of the series of mainstem hydropower dams and reservoirs (Section 5.2.1), as well as by the operation of both Federal and non-Federal upstream multipurpose storage projects. The impoundments have also inundated extensive salmon spawning and rearing habitat. Historically, fall chinook salmon spawned in mainstem reaches from near The Dalles, Oregon, upstream to the Pend Oreille and Kootenai Rivers in Idaho, and to the Snake River downstream of Shoshone Falls. Presently, mainstem production areas for fall chinook salmon are confined to the Hanford Reach of the Columbia River, the Hells Canyon Reach of the Snake River, the mid-Columbia River, and in the tailrace areas downstream from the lower Snake River projects and Bonneville Dam. The Hanford Reach is the only known mainstem spawning area for steelhead. Spawning habitat used historically by LCR chinook salmon, CR chum salmon, and LCR steelhead was probably inundated by the Bonneville pool.

Mainstem habitats in the lower Columbia and Willamette Rivers have been greatly reduced. What once were complex channels with bars, islands, and intricate flow patterns have often been reduced to a single thread. Floodplains have been reduced, off-channel habitat features have been eliminated or disconnected from the main channel, and the amounts of large woody debris in the channels have been greatly reduced. Finally, most of the remaining habitats are affected by flow fluctuations associated with reservoir water management for power peaking, flood control, irrigation, and other operations.

Estuarine habitat has been lost or altered directly through diking, filling, and dredging. Estuarine habitat has also been removed indirectly through changes to flow regulation that affect sediment transport and salinity within specific habitats in the estuary. Not only have rearing habitats been removed, but the habitats needed to support tidal and seasonal movements of juvenile salmon are no longer accessible because connections have been lost.

Major changes in the estuary resulting from anthropogenic alterations include a loss of vegetated, shallow-water habitat and changes in the size, seasonality, and behavior of the plume. These changes have significant consequences for salmonid diversity and population productivity. ESUs with fry and fingerling life-history strategies that use and depend upon these shallow-water habitat areas are most significantly affected by these changes (Fresh et al. 2004).

The lower Columbia River estuary lost about 43% of its historical tidal marsh (from 16,180 to 9,200 acres) and 77% of historical tidal swamp habitats (from 32,020 to 6,950 acres) between 1870 and 1970 (Thomas 1983). One example is the diking and filling of floodplains formerly connected to the tidal river that have resulted in the loss of large expanses of low-energy, off-channel habitat for salmon rearing and migrating during high flows. Similarly, diking of estuarine marshes and forested wetlands within the estuary have removed most of these important off-channel habitats. Sherwood et al. (1990) estimated that the Columbia River estuary lost 20,000 acres of tidal swamps; 10,000 acres of tidal marshes; and 3,000 acres of tidal flats between 1870 and 1970.

The total volume of the estuary inside the entrance has declined by about 12% since 1868 (Sherwood et al. 1990). This study further estimated an 80% reduction in emergent vegetation production and a 15% decline in benthic algal production. The authors analyzed early navigational charts and noted profound bedform changes in the river entrance from year to year. The pre-development river mouth was characterized by shifting shoals, sandbars, and channels forming ebb and flood tide deltas. Prior to jetty construction, the navigable channel over the tidal delta varied from a single, relatively deep channel in some years to two or more shallow channels in other years.

Within the lower Columbia River, diking, river training devices (pile dikes and riprap), railroads, and highways have narrowed and confined the river to its present location. Between the Willamette River and the mouth of the Columbia River, diking, flow regulation, and other human activities have resulted in the confinement of 84,000 acres of floodplain that likely contained large amounts of aquatic habitat (i.e. tidal marsh, and swamp). The lower Columbia River's remaining tidal marsh and swamp habitats are located in a narrow band along the banks of the Columbia River and its tributaries and around undeveloped islands.

Since the late 1800s, the Corps has been responsible for maintaining navigation safety on the Columbia River. During that time, the Corps has taken many actions to improve and maintain the navigation channel. The channel has been dredged periodically to make it deeper and wider and annually for maintenance. To improve navigation and reduce the frequency of maintenance dredging, the navigation channel has also been realigned and hydraulic control structures, such as in-water fills, channel constrictions, and pile dikes, which act as break-waters, have been built. Most of the present day pile dike system was built in the periods 1917-1923 and 1933-1939, with an additional 35 pile dikes constructed between 1957 and 1967.

The existing navigation channel pile dike system consists of 256 pile dikes, totaling 240,000 linear feet. Ogden Beeman and Associates (1997) noted that navigation channel maintenance activities from 1885 to 1985 required closing of river side channels, realigning river banks, removing rock sills, stabilizing river banks, and placement of river "training" features. Most of these habitat alterations were constructed or occurred before the listings of any Pacific salmonids as endangered and threatened species.

These aforementioned physical changes also affect other factors in the riverine and estuarine environment. Tides raise and lower river levels at least 4 feet and up to 12 feet twice every day. The historical range for tides was probably similar, but seasonal ranges and extremes in water surface elevations have certainly changed because of river flow regulation and stream bank development. The salinity level in areas of the estuary can vary from zero to 34 parts per thousand (ppt), depending on tidal intrusion, river flows, and storms. The salinity wedge is believed to have ranged from the river mouth to as far upstream as RM 37.5 in the past. It is now generally believed that the upper edge of the wedge ranges between the mouth and RM 30. The river bed within the navigation channel is composed of a continuously moving series of sand waves that can migrate downstream up to 20 feet per day at flows of 400,000 cfs or greater and at lesser rates at lower flows.

As development has changed the circulation pattern in the estuary, it has increased shoaling rates such that the estuary is now a more effective sediment trap (Independent Science Group 1996). Although the Columbia River is characterized as a highly energetic system, it has been changing as a result of development and is now similar to more developed and less energetic estuaries throughout the world (Sherwood et al. 1990).

In addition, model studies indicate that the hydrosystem and climate change together have decreased suspended particulate matter to the lower river and estuary by about 40% (as measured at Vancouver, Washington) and have reduced fine sediment transport by 50% or more (Bottom et al. 2001). Overbank flow events, important to habitat diversity, have become rare, in part because water storage and irrigation withdrawals prevent high flows, and in part because diking and revetments have increased the "bank full" flow level (from about 18,000 to 24,000 $m^3/s$). The dynamics of estuarine habitat have changed in other ways relative to flow and stream bank development. The availability of shallow (between 10 cm and 2 m depth), low-velocity (less than 30 cm/s) habitat now appears to decrease at a steeper rate with increasing flow than during the 1880s, and the absorption capacity of the estuary appears to have declined.

The significance of these changes for salmonids is unclear. Estuarine habitat is likely to have provided services (food and refuge from predators) to subyearling migrants that resided in estuaries for up to two months or more (Casillas 1999). Historical data from Rich (1920) indicate that small juvenile salmon (< 50 mm), which entered the Columbia River estuary during May, grew 50 mm to 100 mm during June, July, and August. Data from a more contemporary period (Dawley et al. 1986; CREDDP 1980) show neither small juveniles entering the estuary in May nor growth over the summer season.

The Columbia River plume also appears to be an important habitat for juvenile salmonids, particularly during the first month or two of ocean residence. The plume may simply represent an extension of the estuarine habitat. More likely, it represents a unique habitat created by interaction of the Columbia River freshwater flow with the California current and local oceanographic conditions. Ongoing studies show that nutrient concentrations in the plume are similar to nutrient concentrations associated with upwelled waters. Upwelling is a well recognized oceanographic process that produces highly productive areas for fish. Primary productivity, and more important, the abundance of zooplankton prey, is higher in the plume compared with adjacent non-plume waters. Further, salmon appear to prefer low surface salinity, as the abundance and distribution of juvenile salmon are higher and more concentrated in the Columbia River plume than in adjacent, more saline waters. These findings support the notion that the plume is an important habitat for juvenile salmonids. What is not known precisely is how Columbia River flows affect the structure of the plume relative to salmonid biological requirements during outmigration periods, and whether critical threshold flows are needed.

### 5.3.2 Hydrologic Conditions

Hydrologic conditions influence salmonid survival through the migratory corridor by changing the rate of migration; affecting water quality, particularly water temperature, turbidity, and TDG concentrations; and by influencing FCRPS project operations.

Flow regulation, water withdrawal, and climate change have reduced the Columbia River's average flow and altered its seasonality, sediment discharge and turbidity, thereby changing the estuarine ecosystem (National Research Council 1996; Sherwood et al. 1990; Simenstad et al. 1982, 1990; Weitkamp 1994). Annual spring freshet flows through the Columbia River estuary are about one-half of the traditional levels that flushed the estuary and carried smolts to sea, and total sediment discharge is about one-third of nineteenth-century levels. For instance, reservoir storage and flow regulation that began in the 1970s has reduced the 2-year flood peak discharge, as measured at The Dalles, Oregon, from 580,000 cfs to 360,000 cfs (Corps 1999).

Decreased spring flows and sediment discharges have also reduced the extent, speed of movement, thickness, and turbidity of the plume that extended far out and south into the Pacific

Ocean during the spring and summer (Cudaback and Jay 1996; Hickey et al. 1997). Changes in estuarine bathymetry and flow have altered the extent and pattern of salinity intrusion up the Columbia River and have increased stratification and reduced mixing (Sherwood et al. 1990).

The direct effects of flow on juvenile survival are the relationships between flow and travel time and flow and the distribution of fish among the various dam passage routes. In general, the lower the flow through the series of FCRPS reservoirs, the longer the travel time of outmigrating juveniles. The longer juveniles remain in project reservoirs, the greater their exposure to predation, disease, and other mortality factors. Also, the longer juveniles remain in the project reservoirs, the greater the potential that they will residualize (remain in fresh water for months to another year). Changing flows can also affect dam operations as operating protocols are often defined in terms of streamflow criteria. For example, at spring flows of less than 85,000 cfs at Lower Granite Dam, the spill rate and duration are reduced. Spillways are widely considered the safest route of juvenile dam passage (Ferguson et al. 2004). Changing flows indirectly affect juvenile survival by changing water temperatures. Lower flows result in higher summer water temperatures (all other conditions being equal). High summer water temperatures increase disease, predation rates, and thermal stress on juvenile salmonids.

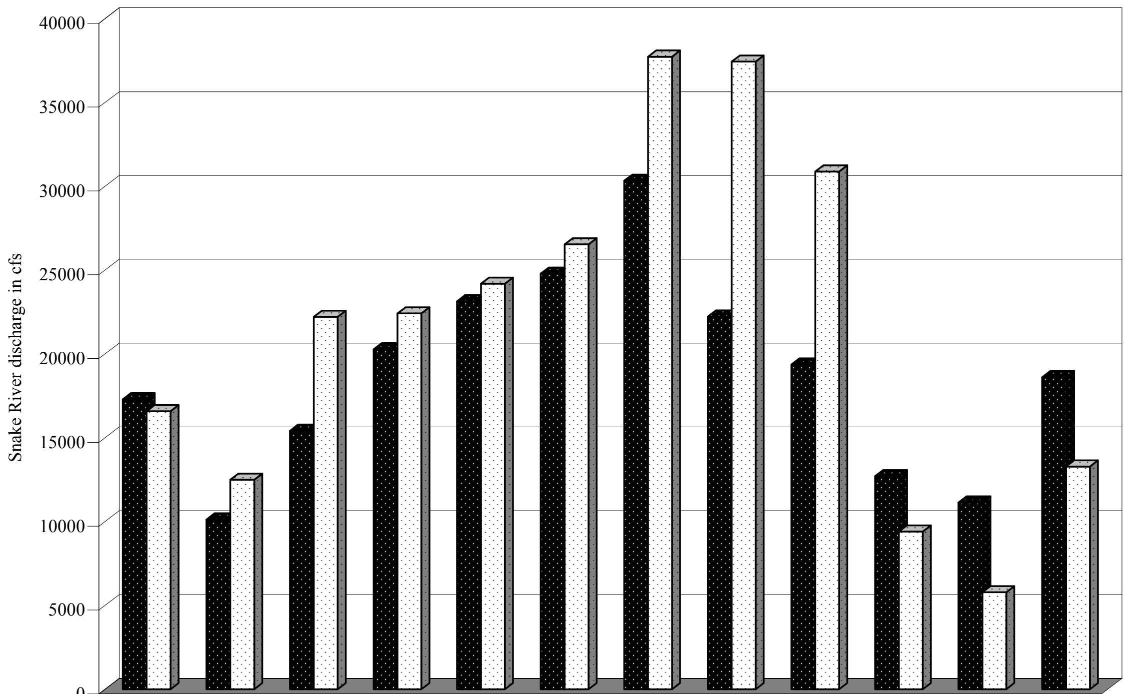
Very high flow conditions can cause high rates of involuntary spill at FCRPS projects in the migratory corridor. High spill rates can generate supersaturated TDG concentrations in downstream waters. This effect is discussed in Section 5.3.3, Water Quality Conditions.

Streamflows are directly affected by the PA and these effects and their associated effects on salmon survival are the focus of the analysis of effects generated in developing this Opinion (Section 6).

Agricultural water use in the Snake and Columbia Basins began around 1850 and accelerated rapidly in the early twentieth century (Volkman 1997). Today, about 85% of water consumption in the basins is associated with irrigated agriculture. For example, at Brownlee Reservoir, all upstream water use reduces flows by about 6 million acre-feet (Maf) annually, about one-third of native flows (USBR 1999). At Lower Granite Dam, upstream water developments consume about 6.4 Maf, about 7% of native flows. At McNary Dam, upstream water uses consume about 12 Maf annually, about 12% of native flows. At Bonneville Dam, about 13.3 Maf is consumed at upstream water developments. This water consumption reduces streamflows primarily during the growing season (April through October), has affected the status of the species in the action area, and is included in the environmental baseline (reference operation). Future water consumption is discussed in Section 7.2, Cumulative Effects.

The principal change in environmental conditions between those currently existing and those under the reference operation (current conditions absent the effects of the USBR's upper Snake project operations) is the change in Snake and Columbia River flows. Because all project facilities are located upstream from Brownlee Reservoir, Idaho, this change is best illustrated by estimated inflows to Brownlee Reservoir (Figure 5-2). This depiction of Snake River flow conditions is intended to illustrate how the baseline hydrology used in this Opinion differs from the existing conditions.

**Figure 5-2.** Mean monthly Snake River inflow (cfs) at Brownlee Dam under current conditions and under the reference operation. Sources: current conditions, BPA HYDSIM model run FRIII_03BIOP2004.xls; reference operation, BPA HYDSIM model run FRIII_USNBIOP_NOIRR.xls.




| | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ■ Current Flows | 17294 | 10122 | 15416 | 20273 | 23136 | 24787 | 30333 | 22230 | 19366 | 12708 | 11138 | 18610 |
| □ Reference Operation | 16584 | 12504 | 22217 | 22417 | 24186 | 26534 | 37731 | 37440 | 30876 | 9413 | 5780 | 13286 |

### 5.3.3 Water Quality Conditions

Water and sediment quality is another important aspect of the environmental condition of the lower Columbia River ecosystem with the potential to affect salmonids' growth and survival.

Water quality in streams throughout the Columbia River Basin has been degraded by human activities such as dams and diversion structures, water withdrawals, farming and grazing, road construction, timber harvest activities, mining activities, and urbanization. Over 2,500 streams and river segments and lakes do not meet Federally approved, State, and tribal water quality standards and are now listed as water quality-limited under Section 303(d) of the Clean Water Act (CWA). Tributary water quality problems contribute to poor water quality where sediment and contaminants from the tributaries settle in mainstem reaches and the estuary.

The importance of three water quality characteristics - water temperature, TDG concentrations, and water and sediment pollutants - are discussed below.

### 5.3.3.1 Water Temperature

Salmonids evolved to take advantage of the natural cold, freshwater environments of the Pacific Northwest. Temperature directly governs their metabolic rate and directly influences their life history. Natural or anthropogenic fluctuations in water temperature can induce a wide array of behavioral and physiological responses in these fish. Feeding, growth, resistance to disease, successful reproduction, sufficient activity for competition and predator avoidance, and successful migrations are all affected by water temperatures (Yearsley 1999). These behavioral and physiological effects may lead to impaired functioning of the individual and decreases viability at the organism, population, and species level.

Williams (2004) noted that multivariate models indicated that the condition that had the strongest effect on survival of yearling chinook salmon through the Snake River was water temperature. For yearling chinook salmon, temperatures above 13°C appeared detrimental to survival. The date on which temperatures at Lower Monumental Dam reached 13°C varied from year to year, ranging from May 7 in 1998 to June 11 in 1997. The average date on which this apparent threshold temperature was reached was May 25 (Williams et al 2004). Zaugg and Wagner (1973) found that gill Na + -K + ATPase (an indicator of migratory readiness) and migratory urge declined at water temperatures of 13°C and higher. Steelhead that migrate too late in the season, when water temperatures are above this threshold, may have a tendency to residualize. For subyearling chinook salmon, Williams et al (2004) noted that average survival was nearly constant for water temperature below 19.3°C, and nearly constant, but considerably lower for water temperature above 20.6°C.

For Snake River fall chinook salmon juveniles, Connor et al (2003) determined that flow and temperature explained 92% of the observed variability in cohort survival from points of release in Hells Canyon to the tailrace of Lower Granite Dam and built a multiple regression model of cohort survival based on these parameters. Cohort survival generally increased as flow increased, and decreased as temperature increased (Connor 2003). Based on the regression model developed, survival is predicted to change by approximately 3% with each change of 100 $m^3/s$ in flow when temperature is held constant. The change in survival is approximately 7% for each 1°C change in temperature when flow is held constant (Connor 2003).

The Snake River from its confluence with the Salmon River at RM 188 to its confluence with the Columbia River has been included on the 303(d) list (a list of impaired waters compiled under Section 303(d) of the CWA) for water temperature by Idaho, Oregon, and Washington. Additionally, Oregon and Washington include most of the mainstem Columbia River on their lists as impaired for temperature. Most of the water bodies in Oregon, Washington, and Idaho that are on the 303(d) list are included because they do not meet water quality standards for temperature. Water temperature alterations affect salmonid metabolism, growth rate, and disease resistance, as well as the timing of adult migrations, fry emergence, and smoltification (EPA 2002). Many factors can cause high stream temperatures, but they are primarily related to land- and water-use practices rather than point-source discharges (Coutant 1999).

Water temperatures in excess of the States of Washington and Oregon's 20°C (68°F) water quality standards (e.g., OAR, Ch. 30, Division 041) stress anadromous salmonids and can directly or indirectly cause mortality (e.g., increase fish susceptibility to disease, increase predation rates of piscivorous fish). Some common actions that have resulted in high stream temperatures are the removal of trees or shrubs that directly shade streams, excessive water withdrawals for irrigation or other purposes, and warm irrigation return flows. Loss of wetlands and increases in groundwater withdrawals have contributed to lower base-stream flows, which in turn contribute to temperature increases. Water temperature is also directly affected by streamflow conditions through the effects of changes in the mass affected by heat flux.

For this Opinion, NMFS has employed both Environmental Protection Agency (EPA) and Corps water temperature modeling. Under the reference operation, EPA (2005) estimated water temperature conditions in the Snake and Columbia Rivers throughout the peak juvenile migration season (April through September) for low, average, and high water years (Table 5-2).

**Table 5-2.** Estimated water temperatures (in °C) at selected FCRPS dams for low, average, and high flow years under the reference operation. Source: EPA 2005.

| | Lower Granite Dam | | | Ice Harbor Dam | | | McNary Dam | | |
|---|---|---|---|---|---|---|---|---|---|
| | Low 2000 | Ave 1995 | High 1997 | Low 2000 | Ave 1995 | High 1997 | Low 2000 | Ave 1995 | High 1997 |
| April | 9.7 | 8.4 | 8.3 | 9.8 | 8.3 | 8.4 | 8.7 | 8.1 | 7.9 |
| May | 12.5 | 11.5 | 10.9 | 13.2 | 11.9 | 11.4 | 12.2 | 11.9 | 11.6 |
| June | 15.5 | 14.5 | 14.1 | 15.9 | 14.6 | 14.5 | 15.3 | 15.1 | 14.8 |
| July | 18.7 | 18.7 | 19.5 | 21.0 | 20.0 | 19.9 | 20.0 | 19.5 | 18.6 |
| August | 20.2 | 19.2 | 19.6 | 22.7 | 21.5 | 23.0 | 21.6 | 20.0 | 21.5 |
| September | 19.0 | 19.6 | 18.4 | 20.9 | 20.6 | 20.1 | 19.7 | 18.3 | 19.2 |

In some instances, these modeling results appear to be counterintuitive. For example, at Lower Granite Dam under the high water conditions of 1997, a lower July water temperature than the average or dry years would be expected, all other conditions being equal. However, the Snake River upstream from Lower Granite Dam is a warmer river than the Clearwater River, the other major Snake River tributary entering Lower Granite Reservoir. Therefore, higher flows in the Snake River can result in warmer water temperatures at Lower Granite Dam. The Corps attempts to control water temperatures at Lower Granite Dam by releasing cold water (7°C) from Dworshak Dam on the Clearwater River at rates up to 14 kcfs. When flows are warm and high coming out of the Snake River Basin, this measure would have a lesser effect on water temperatures at Lower Granite Dam.

### 5.3.3.2. Total Dissolved Gas

High rates of spill at mainstem FCRPS dams can cause high TDG concentrations. High TDG concentrations can cause gas bubble trauma (GBT) in adult and juvenile salmonids resulting in injury or death. Biological monitoring shows that the incidence of GBT in both migrating smolts and adults remains below 1% when TDG concentrations in the upper water column do not exceed the Oregon and Washington water quality standard (110%) and gas waiver levels of 120% in FCRPS project tailraces and 115% in forebays. When those levels are exceeded, there is a corresponding increase in the incidence of signs of GBT. Exceedence of this standard is generally associated with high rates of involuntary spill associated with the peak of the annual runoff hydrograph. Current reservoir operations typically limit gas-generating, high-spill events to a few days or weeks during high-flow years. Historically, TDG supersaturation was considered a major contributor to juvenile salmon mortality, and TDG control has been a focus of efforts to improve salmon survival. The Corps has invested heavily in controlling TDG at its projects in the migratory corridor through the installation of spillway improvements and by managing spill operations to reduce gas entrainment, and thorough TDG monitoring and abatement evaluation.

As part of the TDG abatement program, the Corps has developed spill limits at its projects designed to prevent the creation of adverse TDG conditions downstream. For example, the spill cap at Lower Granite Dam in the 2004 Water Management Plan (Corps 2004) is 43,000 cfs. Using the 50-year simulated hydrology for the environmental baseline (reference operation), the spill cap at Lower Granite Dam would be exceeded on a monthly average basis as follows: March, 1 out of 50; April, 2 out of 50; May, 12 out of 50; and June, 14 out of 50.

#### 5.3.3.3 Pollutants

Background or ambient levels of pollutants in inflows carry cumulative loads from upstream areas in variable and generally unknown amounts. Municipal and industrial waste discharges have occurred in the greater Lewiston, Idaho-Clarkston, Washington area and have been received from larger population centers in the Upper Snake River Basin. Major tributaries and drainages have delivered higher background concentrations of metals, which are generally associated with mining areas that are common in portions of the Clearwater and Salmon Rivers and in tributaries throughout the Upper Snake River.

Current environmental conditions in the Columbia River estuary indicate the presence of contaminants in the food chain of juvenile salmonids including DDT, PCBs, and polyaromatic hydrocarbons (PAH) (NWFSC Environmental Conservation Division 2001). These data indicate that juvenile salmonids within the Columbia River estuary have contaminant body burdens that may already be within the range where sublethal effects may occur, although the sources of exposure could be widespread and are not clear. In field studies, juvenile salmon from sites in the Pacific Northwest have demonstrated immunosuppression, reduced disease resistance, and reduced growth rates due to contaminant exposure during their period of estuarine residence (Arkoosh et al. 1991, 1994, 1998; Varanasi et al. 1993; Casillas et al. 1995a, 1995b, 1998a).

### 5.3.4 Predation

Salmon and steelhead are exposed to high rates of natural predation, particularly during freshwater rearing and migration stages. Ocean predation may also contribute to significant natural mortality, although the levels of predation are largely unknown. In general, salmonids are prey for pelagic fishes, birds, and marine mammals, including harbor seals, sea lions, and killer whales. There have been recent concerns that the rebound of seal and sea lion populations, following their protection under the Marine Mammal Protection Act of 1972, has resulted in substantial mortality for salmonids. In recent years, for example, sea lions have learned to target UWR spring chinook salmon in the fish ladder at Willamette Falls and other spring chinook salmon ESUs in the tailrace area downstream from Bonneville Dam.

Dams and reservoirs are generally believed to have increased the incidence of predation over historical levels (Poe et al. 1994). Effects such as the increase in habitat suitable for predatory fish, warmer near-surface water temperatures that increase their foraging rates, and the delay and aggregation of migrating salmonids in project forebays and tailraces all increase the susceptibility of anadromous fish to predation (NMFS 2004a, Section 5.3.1).

### 5.3.5 Disease

Columbia Basin salmonids co-exist with a range of viruses, bacteria, fungi, and parasites. Some of these organisms have significant effects on salmon populations through mortality or reduced fitness (morbidity). These organisms are collectively known as pathogens. For salmonid and pathogen populations to persist, interactions between host and pathogen, like interactions between predator and prey, must maintain a dynamic balance where neither party is wholly eliminated. Three major factors in this balance have been identified as host, environment, and pathogen. A change in one or more of these three factors will result in a change in the equilibrium, often resulting in large outbreaks of disease (epizootics) which may decimate salmonid populations (Hedrick 1998; Gerstman 2003; Arkoosh et al. 2004).

With the development of the Columbia Basin, a number of factors emerged which have the potential to cause shifts in the host-pathogen equilibria, increasing risks of epizootics. Dams and other impoundments increased summer water temperatures, creating conditions where some pathogens increased their infectivity (rate of spread) and virulence (severity of effects on the host organism), while at the same time stressing salmonids and reducing their resistance to disease (Becker and Fujihara 1978; WDOE 2002; Mesa et al. 2000). The introduction of exotic species and the between-basin transfer of native fishes creates opportunities for the introduction of new pathogens, or for endemic pathogens to increase their range. Large-scale intensive hatchery culture provides conditions where pathogens could spread rapidly within the hatchery, and increases the risk of transfer of disease out of the hatchery through hatchery effluents and the release of infected fish. Changing environmental conditions altered relationships between parasites and their hosts, potentially increasing the severity of parasitic infection. Handling and transport of fish at dams has led to fish being held at much higher densities than observed in the wild, increasing chances of disease transmission. Thus, with changes in host, pathogen, and environment, a shift in host-pathogen relationships from pre-development conditions has occurred.

The effects of disease on wild salmonid populations are notoriously hard to enumerate, and the significance of a particular pathogen may also widely vary among different salmonid populations (Hedrick 1998). Diseases which have been observed to cause significant losses to migrating fish (both hatchery and wild) in the Columbia River system are Columnaris (*Flexibacter columnaris*) (Becker and Fujihara 1978), bacterial kidney disease (*Renibacterium salmoninarum*) (Arkoosh et al. 2004; Elliot et al. 1997), and ceratomyxosis (*Ceratomyxa shasta*) (Ratliff 1981; Bartholomew 1998). With the interruptions of natural disease control mechanisms through shifts in environmental conditions, introductions of new pathogens (or changes in distribution of endemic ones), or introduction of new potential sources of pathogens, such as hatcheries, this equilibrium has been substantially altered and the potential for large epizootics and high losses to salmonid populations has increased.

***Effects of Temperature on Disease.*** In addition to the stress and direct physiological damage suffered by salmonids when exposed to elevated water temperatures, risks of mortality due to disease also increase. There appear to be two primary reasons for this increase. Temperature-related stress reduces the capacity of the fish to resist infection and eliminate pathogens. Pathogens also respond to changes in temperature. There is a particular range of optimum temperatures for each pathogen and in this range the reproduction, infectivity, and virulence of a pathogen are maximized. The combination of reduced resistance of fish and increased virulence and infectivity of a particular pathogen can result in epizootics and high rates of mortality due to disease. In a summary of issues related to temperature criteria for salmon, the EPA (2001) summarized the effects of water temperature on disease risk as follows:

| **Risk** | **Temperature range ($^oC$)** |
|---|---|
| Minimized | <12-13$^o$ |
| Elevated | 14-17$^o$ |
| Severe | 18-20$^o$ |

There are a number of pathogens known in the Columbia Basin which show a direct increase in infectivity and virulence with increased water temperature. Some diseases, such as Columnaris (*Flexibacter columnaris*), are rare within the natural range of water temperatures in the Columbia Basin (i.e., temperatures that would be observed absent man-caused effects) (Becker and Fujihara 1978). A brief summary of Columbia Basin pathogens with the potential for causing increased mortality among salmonids under elevated water temperature conditions is described in Table 5-3.

**Table 5-3.** Fish diseases known from the Columbia Basin showing increases in infectivity and virulence with increasing water temperature (WDOE 2002; EPA 1999; EPA 2001)

| Organism | Disease | Temperature effects | Susceptible species | Severity of effects |
|---|---|---|---|---|
| | | **Bacteria** | | |
| *Flexibacter columnaris* | Columnaris | epizootics strongly related to high water temperature (>15 | All species | Has been observed to cause high levels of mortality among wild and hatchery populations, $^{o}$ C) |
| *Renibacterium salmoninarum* | Bacterial Kidney Disease (BKD) | Increased temperatures reduce infectivity, but increase the severity of infections (time until death) in laboratory trials. | All salmonids, especially chinook and sockeye | Often causes high levels of mortality in hatcheries. High prevalence in some wild fish populations. |
| *Aeromonas salmonicida* | Furunculosis | Epizootics strongly correlated with temperature | All fishes | Has been observed to cause high levels of mortality in the wild and hatcheries |
| Myxobacter sp. | Bacterial Gill Disease (BGD) | Epizootics strongly correlated with water temperature and poor water quality | All fishes | |
| | | **Parasites** | | |
| *Ceratomyxa Shasta* | Ceratomyxosis | Increased temperatures reduced time from exposure to death in laboratory studies. | Salmonids, especially chinook | Has been observe to cause high levels of mortality in the wild and in hatcheries. |
| *Icthyopthirius multifilis* | Ich | Epizootics strongly associated with temps >15 $^{o}$ C | All fishes | Has been observed to cause high levels of mortality in the wild and in hatcheries |

Juvenile salmon and steelhead mortalities from an array of disease have been observed at many fish collection and handling systems in the migratory corridor. Columnaris and BKD are two common diseases observed at mainstem FCRPS juvenile fish collection facilities. In many cases, the proximate causes of fish mortality in the action area are largely unknown. While it is known that juvenile passage survival is lower under low-flow, high-temperature conditions, it is seldom known whether the direct cause of death is thermal stress, increased predation, or increased susceptibility to disease, or a combination of these factors.

### 5.3.6 Artificial Propagation

Artificial propagation programs mandated by Congress under the Lower Snake River Compensation Program are included in the environmental baseline for this consultation. Many artificial propagation facilities under this program were originally authorized to help mitigate for the construction of the four Federal lower Snake River hydroelectric dams. Other Federally funded artificial propagation programs in the Snake Basin are not included in the environmental baseline for this consultation, as they are currently undergoing consultation.

Although located outside of the action area, all Federal and non-Federal artificial propagation programs in the Columbia Basin above Priest Rapids Dam are also part of the environmental baseline for this consultation. They are included because hatchery progeny pass through the lower Columbia River migration corridor and interact with ESA-listed fish that are the focus of this consultation. The current Section 7 biological opinion for hatchery operations associated with unlisted salmon species (for Federally funded programs) and Permit 1347 (for State-operated programs) both expire October 22, 2013. ESA permits (1396, USFWS and 1412, Confederated Tribes of the Colville Reservation) associated with listed steelhead are in place through October 2, 2008, and permit 1395 (issued to WDFW) is in place through October 2, 2013. ESA permit 1300 issued to the USFWS to propagate listed spring chinook salmon is in place through December 31, 2007, and permit 1196 issued to WDFW expires January 20, 2014.

Artificial propagation programs in the Columbia Basin below the confluence with the Snake River are not included in the environmental baseline for this consultation. New ESA authorization is in process for these programs.

Because hatcheries have traditionally focused on providing fish for harvest, it is only recently that the substantial adverse effects of hatcheries on natural populations have been demonstrated. For example, hatchery practices, among other factors, have contributed to the 90% reduction in natural coho salmon runs in the lower Columbia River over the past 30 years (Flagg et al. 1995).

NMFS has identified four primary ways hatcheries harm natural-origin salmon and steelhead: 1) ecological effects, 2) genetic effects, 3) overharvest effects, and 4) masking effects. Ecologically, hatchery-origin fish can prey on, displace, and compete with natural fish. These effects are most likely to occur when hatchery-reared juveniles are released in poor condition and remain in the fresh water for extended rearing periods rather than migrating to marine waters. Hatchery-origin fish also can transmit hatchery-borne diseases, and hatcheries themselves can release disease-carrying effluent into streams. Hatchery-origin fish can affect the genetic variability of native fish by interbreeding with them. Outbreeding depression can result from the introduction of stocks from other areas. Genetic interactions like these can result in fish being less adapted to the local habitats where the original native stock evolved, and may therefore be less productive there.

In many areas, hatchery-origin fish provide increased fishing opportunities. However, when natural fish mix with hatchery-origin fish in these areas, naturally produced fish can be over-harvested. Moreover, when migrating adult hatchery and natural fish mix on the spawning grounds, the health of the natural runs and the habitat's ability to support them can be overestimated because hatchery fish can mask the actual natural run status from surveyors' observations.

The role hatcheries play in the Columbia Basin is being redefined by NMFS' proposed hatchery listing policy, developing environmental impact statements, and recovery planning efforts. These efforts will focus on maintaining and improving ESU viability. Research designed to clarify interactions between natural and hatchery fish and quantify the effects of artificial propagation on natural fish will play a pivotal role in informing these efforts. The final facet of these initiatives is to use hatcheries to create fishing opportunities that are benign to listed populations (e.g., terminal area fisheries).

### 5.3.7 Harvest

***Treaty Indian Harvest.*** Treaty Indian fishing rights are included in the environmental baseline for this consultation. The four Columbia River "Stevens" Treaty Tribes (the Nez Perce, Umatilla, and Warm Springs Tribes, and the Yakama Indian Nation) entered into treaties with the United States in 1855. In exchange for the Indians relinquishing their interest in certain lands, the treaties reserved to the Tribes "exclusive" on-reservation rights and the right to take "fish at all usual and accustomed places in common with citizens of the United States" outside the reservations on the Columbia River and major tributaries. Indian treaty rights, such as hunting and fishing rights, are reserved rights that generally date from time immemorial. See Felix S. Cohen, *Handbook of Federal Indian Law*, 441-448 (1982); *United States v. Winans*, 198 U.S. 371, 381 (1905), 25 S.Ct. 662, 49 L.Ed. 1089 ("In other words, the treaty was not a grant of rights to the Indians, but a grant of right from them -- a reservation of those not granted. There was an exclusive right of fishing reserved within certain boundaries. There was a right outside of those boundaries reserved 'in common with the citizens of the territories").

Starting in 1977, Tribal and State fisheries subject to U.S. v. Oregon have been regulated pursuant to a series of Court orders reflecting Court-approved settlement agreements among the parties. The last long-term agreement, known as the Columbia River Fishery Management Plan (CRFMP), was adopted and approved by the Court in 1988 and expired in 1999. At the Court's direction and under its supervision, the parties are currently in the process of negotiating a new long-term agreement.

During the past 10 years, harvest has been managed pursuant to the CRFMP and successor agreements that contain restraints on the fisheries necessitated by the ESA listings of some of the ESUs. As a result, NMFS has conducted ESA Section 7 consultations and issued no-jeopardy opinions covering these agreements and their impact on ESA-listed species.

Agreed-to and estimated harvest rates for various stocks under the current U.S. v. Oregon agreements are set forth in Tables 5-4 and 5-5. For the purpose of projecting the environmental baseline into the future, these current harvest rates are assumed to continue through the term of this Opinion. In terms of the analysis in the Opinion, it does not matter whether the Tribes harvest all of the harvest available to them or, as has been the practice, allocate a portion of that harvest to the States. Accordingly, to estimate the extent of this baseline harvest, NMFS will presume that treaty and non-treaty harvest rates comparable to the current harvest rates will continue into the future pursuant to Court-approved settlement agreements. In addition, the Colville Confederated Tribal fisheries have been consulted on and remain in effect through October 2012.

***Non-Indian Harvest.*** Non-Indian fisheries include both commercial and sport fishing harvest and mortality. Commercial harvest of listed ESUs occurs as an unintentional bycatch during fisheries aimed at hatchery fish. Intentional sport fishing harvest of listed fish is limited to populations considered healthy. Most hatchery progeny in the basin are marked by the removal of their adipose fins and anglers are required to release unmarked fish in most fisheries to protect listed stocks. However, a small fraction of the unmarked fish caught and released by sport fishermen suffer injury or stress and subsequently die. Estimates of total non-Indian harvests are shown in Tables 5-4 and 5-4 and are considered part of the environmental baseline for this consultation.

**Table 5-4.** Expected harvest rates for listed salmonids in winter, spring, and summer season fisheries in the mainstem Columbia River and in tributary recreational fisheries under the 2001 - 2005 Spring Agreement in U.S. v. Oregon NA - similar estimates not available for other areas. (Table modified from NMFS 2004b)

| ESU | Non-Indian Fisheries | | Treaty Indian Fisheries |
|---|---|---|---|
| | **Mainstem** | **Tributary Fisheries** | **Mainstem** |
| Snake River fall chinook | 0 | 0 | 0 |
| Snake River spring/summer chinook | <0.5-2.0%[a] | NA | 5.0-15.0%[a] |
| Upper Columbia River spring chinook | <0.5-2.0%[a] | NA | 5.0-15.0%[a] |
| Lower Columbia River chinook | 2.7%[b] | NA | 0 |
| Upper Willamette River chinook | <15%[d] | -[d] | 0 |
| Snake River steelhead | | | |
| A-run | 0.2% | 2.5%[e] | 2.7%[f] |
| B-run | 0 | 2.5%[e] | 0[f] |
| Upper Columbia River steelhead | | | |
| Naturally-produced | 0.6% | NA | 3.8% |
| Hatchery-produced | 4.5% | NA | 2.7% |
| Mid-Columbia River steelhead | <2.0%[g] | NA | 3.6% |
| Lower Columbia River steelhead | <2.0%[g] | NA | 1.6% |
| Upper Willamette River steelhead | <2.0%[g] | <1.2% | 0 |
| Lower Columbia River coho | 0 | 0 | 0 |
| Columbia River chum | 0 | 0[h] | 0 |
| Snake River sockeye | <1.0% | 0 | <7.0% |

[a] Allowable harvest rate varies depending on run size.
[b] Spring component of the Lower Columbia River ESU only.
[c] Impacts in tributary fisheries will be population specific depending on where the fisheries occur.
[d] Harvest rate limited to 15% or less in all non-Indian mainstem and tributary fisheries.
[e] Maximum harvest rate applied to wild fish passing through terminal fishery areas where hatchery fish are being targeted; hooking mortality of 5% applied to an assumed 50% encounter rate. Harvest rates to stocks not passing through targeted terminal fishing areas will be less.
[f] B-run steelhead of the current return year are primarily caught in fall season fisheries. However, a portion of the summer steelhead run holds over in the Lower Columbia River above Bonneville dam until the following winter and spring; these fish, thought to be mostly A-run, are caught in fisheries in those seasons.
[g] Harvest rate limits for winter-run populations.
[h] Chum may be taken occasionally in tributary fisheries below Bonneville Dam. Retention is prohibited.

**Table 5-5.** Expected harvest rates for listed salmonids in fall season fisheries in the mainstem Columbia River under the 2004 Fall Agreement in U.S. v. Oregon. (Table modified from NMFS 2004b).

| ESU | Non-Indian Fisheries | Treaty Indian Fisheries |
|---|---|---|
| Snake River fall chinook | 8.25% | 23.04% |
| Snake River spring/sum chinook | 0 | 0 |
| Upper Columbia River spring chinook | 0 | 0 |
| Lower Columbia River chinook | | |
| Spring component | 0% | 0% |
| Tule component | 12.4% | 0% |
| Bright component | 11.8% | 0% |
| Upper Willamette River chinook | 0 | 0 |
| Snake River steelhead | | |
| A-run | ≤2% (1.1%)[a] | 3.4% |
| B-run | ≤2% (1.7%)[a] | 15% (13.6%)[a] |
| Upper Columbia River steelhead | | |
| Natural-origin | ≤2% (1.1%)[a] | 3.4% |
| Hatchery-origin | 10.9% | 5.7% |
| Mid-Columbia River steelhead | ≤2% (1.1%)[a] | 3.4% |
| Lower Columbia River steelhead | ≤2% (0.3%)[a] | 0.1% |
| Upper Willamette River steelhead | 0 | 0 |
| Lower Columbia River coho | 6.4% | 0 |
| Columbia River chum | 5% (1.6%)[a] | 0% |
| Snake River sockeye | [b] | [b] |

[a]Maximum proposed harvest rates with the expected harvest rates associated with the proposed fisheries shown in parenthesis.

[b]8% cap (combined Tribal and non-Tribal harvest)

### 5.3.8 Population Response to Environmental Variation

The abundance of salmonid populations is substantially affected by changes in the freshwater and marine environments that are in turn the result of large-scale environmental variations. For example, large-scale climatic regimes, such as El Niño, affect changes in ocean productivity. Much of the Pacific Coast was subject to a series of very dry years during the first part of the 1990s and since 2000. In the latter 1990s, severe flooding adversely affected some stocks. For example, the low return of Lewis River bright fall chinook salmon in 1999 is attributed to flood events during 1995 and 1996.

Among the known variations in ocean conditions are the phenomena termed El Niño and the Pacific Decadal Oscillation (PDO).

El Niño is a disruption of the ocean-atmosphere system in the tropical Pacific having important consequences for global weather patterns and near-shore Pacific Ocean productivity (http://www.pmel.noaa.gov/tao/elnino/gif/summer_winter1-nns.gif). Among these consequences are warmer near-surface ocean water temperatures along the U.S. west coast, and generally warmer, drier weather in the Pacific Northwest. This warmer surface layer reduces thermodynamic upwelling off the U.S. coast, reducing nutrient inputs to the euphotic zone, which reduces near-shore ocean productivity. This reduction in productivity has been shown to reduce juvenile salmon growth and survival (Mantua and Francis in press). Warmer surface waters can also change the spatial distribution of marine fishes with potential predator-prey effects on salmon. The warmer, drier weather in the Pacific Northwest often associated with El Niño can also cause or increase the severity of regional droughts. Droughts reduce streamflows through the Columbia and Snake River migratory corridor, increase water temperatures, and reduce the extent of suitable habitat in some drainages. Each of these physical effects has been shown to adversely affect salmon survival. Thus, El Niño events can present a substantial drag on anadromous fish populations.

> The PDO is a long-lived El Niño-like pattern of Pacific climate variability. While the two climate oscillations have similar spatial climate fingerprints, they have very different behavior in time. Fisheries scientist Steven Hare coined the term "Pacific Decadal Oscillation" (PDO) in 1996 while researching connections between Alaska salmon production cycles and Pacific climate. Two main characteristics distinguish the PDO from El Niño. First, 20th century PDO "events" persisted for 20 to 30 years, while typical El Niño events persisted for 6 to 18 months. Second, the climatic fingerprints of the PDO are most visible in the North Pacific/North American sector, while secondary signatures exist in the tropics. The opposite is true for El Niño. Several independent studies find evidence for just two full PDO cycles in the past century. "Cool" PDO regimes prevailed from 1890-1924 and again from 1947-1976, while "warm" PDO regimes dominated from 1925-1946 and from 1977 through (at least) the mid-1990s. Shoshiro Minobe has shown that twentieth century PDO fluctuations were most energetic in two general periodicities, one from 15 to 25 years, and the other from 50 to 70 years. (Quoted from: http://tao.atmos.washington.edu/pdo/.)

Major changes in northeast Pacific marine ecosystems have been correlated with phase changes in the PDO. Warm eras have seen enhanced coastal ocean biological productivity in Alaska and inhibited productivity off the west coast of the contiguous United States, while cold PDO eras have seen the opposite north-south pattern of marine ecosystem productivity.

Causes for the PDO are not currently known. Likewise, the potential predictability for this climate oscillation is not known. Some climate simulation models produce PDO-like oscillations, although often for different reasons. Discovery of the mechanisms giving rise to PDO will determine whether skillful, decades-long PDO climate predictions are possible. For example, if PDO arises from air-sea interactions that require 10-year ocean adjustment times, then aspects of the phenomenon will (in theory) be predictable at lead times of up to 10 years. Even in the absence of a long-term predictive understanding, PDO climate information improves season-to-season and year-to-year climate forecasts for North America because of its strong tendency for multi-season and multi-year persistence. From a societal impacts perspective, recognition of PDO is important, because it shows that "normal" climate conditions can vary over time periods comparable to the length of a human's lifetime.

Recent evidence suggests that marine survival of salmonids fluctuates in response to the PDO's 20- to 30-year cycles of climatic conditions and ocean productivity (Cramer et al. 1999). Ocean conditions that affect the productivity of Northwest salmonid populations appear to have been in a low phase of the cycle for some time and an important contributor to the decline of many stocks. The survival and recovery of these species will depend on their ability to persist through periods of low natural ocean survival, but the mechanism whereby stocks are affected is not well understood. The pattern of response to these changing ocean conditions has differed among stocks, presumably due to differences in their ocean timing and distribution. NMFS presumes that juvenile fish survival is driven largely by events occurring between ocean entry and recruitment to a subadult life stage. One indicator of early ocean survival can be computed as a ratio of coded-wire-tag (CWT) recoveries of subadults relative to the number of CWTs released from that brood year. Time series of survival rate information for UWR spring chinook salmon, Lewis River fall chinook salmon, and Skagit fall chinook salmon show highly variable or declining trends in early ocean survival, with very low survival rates in recent years (NMFS 1999b).

### 5.3.9 Dam and Reservoir Passage

As stated above, the eight Federal dams on the mainstem Columbia and lower Snake Rivers that dominate the characteristics of fish habitat in the migratory corridor in the action area from the upstream limit of Lower Granite Reservoir on the Snake River to Bonneville Dam on the Columbia River, are part of the environmental baseline. A substantial amount of juvenile mortality occurs in this reach and delay in passing the dams can affect adult survival and may affect fecundity.

The effects of changes in flow due to the operation and maintenance of the USBR's Upper Snake Basin projects on dam and reservoir passage survival through the mainstem Columbia and lower Snake River FCRPS projects are a focus of the analysis conducted for this Opinion. The 2004 FCRPS UPA included an array of measures to improve dam passage survival. Those improvements that have already occurred or are expected to occur within the next year (by spring 2006) are included in the near-term environmental baseline analysis. The effects of those system configuration improvements are expected to continue until the long-term FCRPS configuration improvements are implemented fully by 2014. FCRPS fish passage facility improvements and operations beyond 2014 are undefined but, for the purposes of this consultation, are assumed to result in survival rates that are the same or higher than those estimated in the long-term (2014) analysis in the 2004 FCRPS Biological Opinion (NMFS 2004a). Thus, for the purposes of this consultation, the long-term effects of all of those FCRPS configuration improvements are assumed to remain about the same as those estimated in the long-term (2014) analysis and are expected to continue throughout the term of this biological opinion as part of the long-term environmental baseline.

### 5.3.9.1 Passage Effects on Juvenile Salmon and Steelhead Survival

Juvenile salmon dam and reservoir passage survival has been the subject of extensive research and evaluation and has dominated efforts taken to improve survival of the species through numerous ESA Section 7 consultations.

NMFS placed the first Pacific Northwest salmon ESU on the Endangered Species list in 1991. Since then, NMFS and the FCRPS Action Agencies have engaged in numerous consultations. The focus of those consultations has been on the survival of listed juvenile salmon and steelhead as they migrate through the FCRPS and measures to improve it. Biological opinions outlining a number of proposed operations and structural configuration changes to FCRPS dams designed to improve juvenile survival were issued in 1993, 1994, 1995, 1998, 2000, and 2004. Measures taken to improve juvenile salmon survival through the FCRPS migratory corridor include: water management to increase spring and summer migration season flows, juvenile collection systems and transportation programs, voluntary spills at FCRPS dams, improved spillway juvenile passage efficiency (e.g., removable spillway weirs [RSW]), predatory fish control, and other measures. As a result of these operations and configuration improvements, juvenile survival through the FCRPS migration corridor has improved significantly since the early 1990s. For Snake River spring/summer chinook salmon juveniles migrating in-river, Williams et al. (2004) estimated survival through the eight mainstem Federal dams is now between 28% and 58%, compared with an estimated survival rate during the 1970s of 3% to 30% (Williams et al. 2001). For Snake River steelhead juveniles migrating in-river, Williams et al. (2004) estimated survival through the eight mainstem Federal dams to currently range between 4% and 50%, compared with an estimated survival rate during the 1970s of 1% to 27% (Williams et al. 2001). The transportation of smolts from the Snake River and McNary Dam on the Columbia River has also improved FCRPS system passage survival rates.

Although changes in FCRPS operations and configuration, including juvenile transportation around portions of the Federal hydrosystem, have improved juvenile passage survival, periods of warm weather and low runoff continue to cause high rates of mortality among out-migrants in Lower Granite Reservoir. Lower Granite is the uppermost FCRPS reservoir in the migratory corridor and juvenile fish must pass through this reach without the aid of transportation (i.e., the juvenile collection facilities are located downstream at Lower Granite Dam).

**5.3.9.1.1 Methods Used to Estimate Juvenile Passage Survival Rates.** The juvenile “survival gap” approach to estimating the effect of the PA (Section 6) requires a comparison to estimated survivals under the environmental baseline (as defined by the reference operation). For this analysis, NMFS employed the Simulated Passage model (SIMPAS [NMFS 2004a]). Briefly, the SIMPAS model was calibrated to empirical reach survival data for SR spring/summer chinook salmon (1994-2003), SR steelhead (1994-2003), and SR fall chinook salmon (1995-2001 and 2003) migration through the FCRPS projects. Various conditions, such as total flow and spill levels, as well as dam passage parameters in the model were adjusted to simulate the effect the reference operation would have had on juvenile survival each year under those conditions. Details of the SIMPAS analysis are provided in Appendix A. Survival of additional ESUs was inferred from the passage of the three modeled ESUs through the appropriate mainstem projects.

Juvenile survival estimates for ESUs passing through one or more FCRPS projects under the reference operation are presented in Table 5-6.

Factors influencing FCRPS dam and reservoir passage survival of juvenile salmon and steelhead included in our SIMPAS analysis are briefly described below.

- Relationships Between Flow and Reservoir Survival

  FCRPS project reservoirs increase the time required for juvenile migration. This delay affects survival by increasing the time the fish are exposed to mortality vectors (e.g., disease, predators, adverse water temperatures); disrupting their time of arrival in the estuary (i.e., estuary arrival timing may affect predator/prey relationships and other environmental conditions); depleting energy reserves; and, for steelhead, delay has been shown to cause residualism (a loss of migratory behavior). For those fish not collected and transported, a substantial percentage of the juvenile outmigrant mortality occurs in the FCRPS reservoirs (e.g., about half of juvenile fall chinook salmon mortality occurs in the reservoirs), so reducing migration delays is a focus of past and present actions to improve juvenile outmigrant survival through the FCRPS.

- Dam Passage Parameters

  FCRPS dam passage parameters were estimated from a review of the literature, including summaries in Ferguson et al. (2004). These parameters are important because dams impede the safe passage of juveniles. Some juvenile mortality is associated with all routes of passage at dams, but turbines cause the highest direct mortality (Whitney et al. 1997), and the use of spillways results in the lowest direct mortality (NMFS 2000b). Some passage routes have additional effects, such as the increase in TDG caused by spill. In general, higher dam passage survival occurs when a high proportion of juveniles are routed past the projects in a manner that avoids passing them through turbines. The proportion of smolts that pass a project through either bypass systems or spillways, also described as project fish passage efficiency (FPE), varies by species composition and may vary within a season and between years for a single species with changes in smolt condition, environmental conditions, and project operations.

- Survival of Transported Fish

  Fish placed on barges are assumed to have a 98% survival rate to the point of release. In the analyses of ESUs that are transported from FCRPS mainstem Snake and Columbia River collector projects, the survival rate of transported fish is adjusted by estimates of the differential survival rate of transported fish, compared to in-river migrants, below Bonneville Dam. This ratio (referred to as "D") essentially adjusts transported and non-transported juveniles to Bonneville Dam equivalents. Empirical estimates of D in Williams et al. (2004) were applied to SR spring/summer chinook salmon and SR steelhead. Mean estimates based on a range of water years were applied.

**Table 5-6.** Estimated average juvenile survival rates through the FCRPS under the near-term reference operation. Estimated survivals in the free-flowing river (survival in the absence of the FCRPS dams) are presented for comparison. These estimates do not include possible post-Bonneville latent mortality of in-river migrants. Source: NMFS staff (Appendix A).

| ESU | Estimated Juvenile In-river Survival Rate | Estimated Juvenile System Survival Rate (including transport latent effects) | Estimated Free-Flowing River Survival Rate[h] |
|---|---|---|---|
| SR Spring/Summer Chinook Salmon[a] | 53.1% (43.9% to 59.5%) | 52.2% (48.0% to 55.2%) | 78.6% |
| SR Fall Chinook Salmon[a,g] | 13.1% (3.0% to 21.6%) 4.9 in-river fish per 1000 @ LGR pool alive below BON (1.0-9.0) | N/A | 50.8% |
| UCR Spring Chinook Salmon | 67.5% (52.5% to 74.0%) | N/A | 85.5% |
| LCR Chinook: | | | |
| Gorge Fall MPGs[b] | 86.0% (81.8% to 97.2%) | N/A | 95.5% |
| Gorge Spring MPGs[c] | 90.2% (84.9% to 92.9%) | N/A | 98.4% |
| Below BON Dam MPGs | N/A | N/A | N/A |
| UWR Chinook Salmon | N/A | N/A | N/A |
| SR Steelhead[a] | 34.7% (8.2% to 46.1%) | 50.0% (42.9% to 54.8%) | 82.1% |
| UCR Steelhead | 51.2% (22.3% to 64.6%) | N/A | 87.9% |
| MCR Steelhead:[d] | | | |
| Passing MCN-BON | 51.2% (22.3% to 64.6%) | N/A | 88.9% |
| Passing JDA Pool-BON | 59.7% (31.0% to 74.4%) | N/A | 91.5% |
| From JDA Dam-BON | 73.2% (44.2% to 89.8%) | N/A | 95.6% |
| Passing TDA-BON | 76.2% (45.9% to 93.3%) | N/A | 96.4% |
| Passing BON Dam | 86.3% (64.7% to 97.4%) | N/A | 99.1% |
| LCR Steelhead:[e] | | | |
| Passing BON Dam | 86.3% (64.7% to 97.4%) | N/A | 99.1% |
| Below BON Dam | N/A | N/A | N/A |
| UWR Steelhead | N/A | N/A | N/A |
| CR Chum | N/A | N/A | N/A |
| SR Sockeye | N/A | N/A | N/A |
| LCR Coho[f] | 90.2% (84.9% to 92.9%) | N/A | 95.5% |

[a] The estimated juvenile in-river survival rates shown in this table for transported ESUs are only for those fish that remain in-river for their entire juvenile migration and are not transported.
[b] Estimated juvenile survival rates for LCR (fall) chinook salmon are based on per-project survival rate of SR fall chinook salmon.
[c] Estimated juvenile survival rates for LCR (spring) chinook salmon are based on per-project survival rate of SR spring/summer chinook salmon.
[d] Estimated juvenile survival rates for MCR steelhead are based on per-project survival rate of SR steelhead.
[e] Estimated juvenile survival rates for LCR steelhead are based on per-project survival rate of SR steelhead.
[f] Estimated juvenile survival rates for LCR coho salmon are based on per-project survival rate of SR spring chinook salmon.

| ESU | Estimated Juvenile In-river Survival Rate | Estimated Juvenile System Survival Rate (including transport latent effects) | Estimated Free-Flowing River Survival Rate[h] |
|---|---|---|---|

g Applies only to subyearling life history strategy. An unknown proportion of fish with yearling strategy will have survival rates more closely resembling those of SR spring/summer chinook.
h Free-flowing river survival rates shown are estimated for migration under pre-project conditions based on survival rates in un-impounded river reaches per methods outlined in Ferguson (2004) and Smith (2004).

- Calculation of In-River Survival Rates for ESUs That Are Transported and Estimation of Abundance for SR Fall Chinook Salmon

  In-river survival rates through the FCRPS projects were estimated for all three Snake River ESUs using the SIMPAS model. These survival rates were estimated by modeling an operation without transportation from collector projects, but with all other factors identical. These survival rates only apply to the small fraction of fish that migrates entirely in the river under the reference operation (and under the proposed action analyzed in Section 6).

- Consideration of Alternative Life History Strategies for SR Fall Chinook Salmon

  Recent evidence suggests that SR fall chinook salmon follow both a subyearling and yearling migration strategy (Connor et al. 2004). The SIMPAS model analysis considered only the subyearling life history phase for SR fall chinook salmon and did not include in the analysis any additional survival that would be afforded the yearling life history. The survival of the yearling phase of SR fall chinook salmon would likely be much higher, because they would migrate at a larger size and under cooler water conditions during the fall, winter or early spring of the following year. Accordingly, their survival rates would likely be closer to that of yearling SR spring/summer chinook salmon.

- Latent Mortality of In-River Migrants

  Williams et al. (2004) questioned the validity of concluding that latent mortality associated with migration through the FCRPS projects exists and also making estimates of the magnitude of latent mortality based on stocks from very different river basins. Nonetheless, in reviewing ongoing scientific debate on this issue (e.g., Schaller et al. 1999; Zabel and Williams 2002), Williams et al. (2004) considered several possible alternative hypotheses for mechanisms leading to latent mortality and concluded that, "Clearly some level of latent mortality exists," noting that, for in-river migrants, hydropower system-related latent mortality ranges somewhere from very weak to potentially strong. Further, NMFS has little data at present by which to discern among this broad range of possibilities.

  In this Opinion, it is not necessary to estimate overall FCRPS hydrosystem-related latent mortality unless it differs between the reference operation and the proposed operations for the USBR's Upper Snake Basin projects. The relevant consideration in NMFS' survival analysis is the change in latent mortality associated with various dam operations.

NMFS submits that most of the hypothesized causes of latent mortality would be present under both the reference and proposed action operations, since they are related to the existence of the FCRPS dams. Those differences in survival are considered in the survival gap analysis, which reflects differences in direct mortality. Latent mortality would be the difference in post-Bonneville mortality that would be attributable to the percentage of juvenile fish passing through spillways rather than bypasses or turbines and from fish arriving to the estuary earlier in the season. At present, it is uncertain whether different passage routes result in different levels of latent mortality (Williams et al. 2004) or, if they do, what the magnitude of the effect might be. NMFS did not perform any quantitative estimate of this potential effect in this Opinion.

#### 5.3.9.2 Passage Effects on Adult Salmon and Steelhead

Adult salmon and steelhead must pass up to eight FCRPS dams and reservoirs in the action area to reach their natal spawning streams and river reaches. Each FCRPS project within the action area imposes stresses on migrating adults. Those project-induced effects most likely to adversely affect adult survival are delay and delay-induced predation, water quality changes (e.g., TDG concentrations and water temperatures), and fallback and volitional downstream passage (e.g., steelhead kelts).

***Delay.*** To pass each mainstem FCRPS dam, adult fish must successfully locate and ascend the project fish ladder(s). The ability to successfully pass each dam has been found to be affected by project configuration and various operating characteristics, principally attraction flow rates, project spill patterns, and powerhouse discharge patterns. However, Bjornn et al. (2000) estimated that the median time to transit the lower Snake River in 1993 was the same or less with dams than it would be without dams, suggesting that adult passage timing through the FCRPS dams and reservoirs is relatively unaffected by the FCRPS. This is due to the faster transit times through project reservoirs than would occur in a naturally flowing river combined with any dam passage delays.

Available data suggest that mainstem FCRPS projects with well designed and carefully operated fishways result in very low mortality rates for migrating adults. High per-project and system survivals indicate adult salmonid biological requirements are generally being met during passage through the FCRPS under the environmental baseline.

Increasing pinniped predation of adult salmon and steelhead near the fishway entrances at Bonneville Dam is a concern for all ESUs that have populations upstream of Bonneville Dam. Efforts to evaluate and minimize this problem are part of the 2004 FCRPS UPA (Corps et al. 2004). As solution of this problem is uncertain, pinniped predation at Bonneville Dam’s fishway entrances is part of the environmental baseline for this consultation.

***Fallback and Volitional Downstream Passage***. Fallback refers to adult fish that pass a dam and then are entrained in the spillway, navigation lock, or powerhouse intakes, and pass back through the dam. Fallback of adult spring/summer chinook salmon passing mainstem dams during spill has been found to reduce the number of fish that passed between tops of ladders at Bonneville Dam and Lower Granite or Priest Rapids Dams (after adjustments for harvest). Fallback of steelhead at Bonneville and Ice Harbor Dams similarly has been found to reduce escapement (Keefer and Peery 2004). During 1996-2002, escapement, on average, was lower for fallback fish by 6.5% for spring/summer chinook salmon ($P<0.05$), 19.5% for fall chinook salmon ($P<0.005$), and 13.2% for steelhead ($P<0.005$) (Keefer et al. 2004). Multiplying the percentage reduction in escapement for fish that fall-back by the percentage of fish that actually fallback provides an estimate of the reduction in overall system escapement (e.g., steelhead: 13.2% lower escapement for fallback fish * 21.4% fish that fell back = 2.82% reduction in escapement). Accordingly, average reductions in overall run escapements were estimated at 1.30% (range=0.46-2.27%), 2.26% (range=1.32-2.91%) and 2.82% (range = 1.34-4.02%) for spring/summer chinook salmon, fall chinook salmon, and steelhead, respectively as a result of dam passage.

However, system-wide adult passage information showed no significant difference in spring/summer chinook salmon and steelhead escapement due to fallback during spill (about 30-50 kcfs) and no spill periods in 2001 (Keefer and Peery 2004). Escapements of adult steelhead from Bonneville to Lower Granite Dam adjusted for harvest in 2000, 2001, and 2002, were very similar (87.6, 85.2, and 85.6%, respectively), even though 2001 had very little spill at dams compared with 2000 and 2002. No differences ($P<0.05$) in escapement were found for fallback of spring/summer and fall chinook salmon with and without spill for all years (1996-2002) pooled (Keefer et al. 2004). These similar escapements with and without spill may be due to so few fish falling back during non-spill periods. Further, with all years combined, steelhead escapement was significantly higher ($P=0.002$) during no spill at John Day Dam, and marginally higher ($P=0.056$) during no spill at Bonneville Dam.

***Steelhead Kelts***. Only recently have studies been conducted to identify kelt (post-spawning, downstream-migrating adult steelhead) numbers and to investigate downstream passage success and route-specific passage at dams. Studies conducted since 2000 have shown that over 13,000 kelts passed John Day Dam, and 83% of the kelts observed at Lower Granite Dam were females. For fish tagged and released at Lower Granite Dam, 3.8%, 13.3%, and 34.4% were detected below Bonneville Dam in 2001, 2002, and 2003, respectively (Boggs and Peery 2004). Migration rates in 2003 were positively correlated with river flow ($P<0.0001$, $R^2 = 0.63$). Conditions that provided the 34% survival to below Bonneville Dam in 2003 include spill at dams and a very large freshet in late May/early June when kelts were migrating.

Repeat spawning rates for Snake River steelhead currently average less than 2% (Ferguson et al. 2004). This is about the same repeat spawning rate observed by Whitt (1954) when returning fish only had to negotiate two dams compared to the current eight, suggesting that factors other than dam passage may have a more significant effect on kelt survival.

***Sublethal Effects***. Adult salmon exposed to suboptimal water quality conditions in the migratory corridor and/or delayed by FCRPS dams may succeed in reaching their spawning grounds yet exhibit poor spawning success due to sublethal dam passage experience. For example, stressed fish are known to produce smaller and fewer eggs than fish in excellent condition. Information is not currently available to determine whether such sublethal effects occur as a result of FCRPS dam passage or whether such effects are biologically significant.

### 5.3.10 Anticipated Changes in Environmental Baseline Conditions in the Action Area

Over the 30-year life of this Opinion, numerous changes in the action area environment are likely. For those anticipated future actions for which ESA Section 7 consultations have been completed, the nature and characteristics of anticipated changes in the action area environment are evaluated as part of the environmental baseline for this Opinion. Those actions anticipated to be completed or to show marked effects on the environmental baseline only after March 2006 are part of the long-term environmental baseline for this consultation and are described below.

The Corps constructed riprap levees along the lower Snake and Clearwater Rivers and continues to regularly dredge sediment from channels in the upper part of Lower Granite Reservoir in order to maintain flood conveyance and navigation channels to ports in the Lewiston and Clarkston area. These actions were analyzed in NMFS' March 15, 2004, Biological Opinion, "Lower Snake and Clearwater Rivers 2004-2005 Dredging Snake River fall chinook salmon, Snake River spring/summer chinook salmon, and Snake River steelhead" (NMFS 2004d), and are part of the environmental baseline for this Opinion. Discharge from Potlatch Pulp and Paper Mill in Lewiston, Idaho, into the surface waters and sediments in the lower Clearwater and Snake Rivers is expected to increase levels of total suspended solids and elevate concentrations of some organic constituents. This action was analyzed in NMFS' April 2, 2004, Biological Opinion, "Potlatch Pulp and Paper Mill, Lewiston, Idaho, National Pollution Discharge Elimination System (NPDES) Permit No.: ID-000116-3 for the discharge of effluents into the Snake River, Nez Perce County, Idaho and Asotin County, WA (1 Project)" (NMFS 2004e).

The 2004 FCRPS UPA includes an array of actions that will be completed or show marked effect on the environment after March 2005 (Corps et al. 2004). As the various measures in the UPA are implemented; NMFS anticipates dam passage survival, particularly for juvenile fish, will continue to improve. The long-term environmental baseline analyzed for this Opinion includes all the configuration and operational changes and the increased predator control proposed in the 2004 FCRPS UPA (Corps et al. 2004).

Several actions in the 2004 FCRPS UPA are designed to improve the performance of fish protection systems (e.g. improved inspections, maintenance, and spare part inventories). Although these actions are expected to improve fish survival within the action area for this Opinion, their effects are implicitly included in our analysis in that our approach assumes that all fish protection systems are constantly functioning at their normal performance levels. Other 2004 FCRPS UPA actions that will provide greater system flexibility (e.g., reducing electrical transmission system constraints) are important to facilitating an adaptive management approach to fish protection, but the fish survival benefits are impossible to quantify at this time. Others are likely to improve fish survival outside the action area for this Opinion (e.g., tributary habitat enhancements).

#### 5.3.10.1 Anticipated Operations and Configurations Improvements at FCRPS Dams That Will Improve Long-term Fish Survival in the Action Area

In their 2004 FCRPS UPA and subsequent Records of Decision, the Action Agencies committed to numerous fish passage facility improvements. In addition, individual dams will be operated as further detailed in the water management plans, the implementation plans, the processes afforded through the Regional Forum, and the project decision documents. These measures include a number of actions that would measurably improve juvenile passage survival. NMFS modified SIMPAS parameters to simulate these long-term FCRPS operations and configuration improvements and estimated juvenile passage survival in the long-term environmental baseline (Table 5-7). Appendix A describes the anticipated system configuration and operation changes included in the long-term environmental baseline.

#### 5.3.10.2 Expanded Predator Control

The FCRPS Action Agencies will expand efforts to reduce predation of juvenile salmon by birds and other fish. Caspian tern management actions are expected to be implemented as early as 2005 (pending completion of environmental review and approval), with resulting juvenile survival improvements as early as 2006. Increased incentives under the NPMP will also improve the survival of juveniles from all ESUs in the Columbia Basin. It is not currently possible to quantitatively estimate the long-term juvenile survival improvements for listed ESUs from these expanded predator control efforts.

**Table 5-7**. Estimated average juvenile survival rates through the FCRPS under the long-term reference operation. Estimated survivals in the free-flowing river (survival in the absence of the FCRPS dams) are presented for comparison. These estimates do not include possible post-Bonneville latent mortality of in-river migrants. Source: NMFS staff (Appendix A)

| ESU | Estimated Juvenile In-river Survival Rate | Estimated Juvenile System Survival Rate (including transport latent effects) | Estimated Free-Flowing River Survival Rate[h] |
|---|---|---|---|
| SR Spring/Summer Chinook Salmon[a] | 58.5%<br>(49.1% to 64.9%) | 53.5%<br>(49.5% to 57.3%) | 78.6% |
| SR Fall Chinook Salmon[a,g] | 14.9% (3.4% to 24.5%)<br>6.2 in-river fish per 1000 @ LGR pool alive below BON<br>(2.4-10.8) | N/A | 50.8% |
| UCR Spring Chinook Salmon | 73.4%<br>(58.0% to 80.6%) | N/A | 85.5% |
| LCR Chinook:<br>Gorge Fall MPGs[b]<br><br>Gorge Spring MPGs[c]<br><br>Below BON Dam MPGs | <br>86.1%<br>(81.9% to 97.3%)<br>90.9%<br>(85.0% to 94.1%)<br>N/A | <br>N/A<br><br>N/A<br><br>N/A | <br>95.5%<br><br>98.4%<br><br>N/A |
| UWR Chinook Salmon | N/A | N/A | N/A |
| SR Steelhead[a] | 38.0%<br>(9.0% to 50.8%) | 50.5%<br>(43.0% to 54.9%) | 82.1% |
| UCR Steelhead | 55.4%<br>(24.3% to 69.8%) | N/A | 87.9% |
| MCR Steelhead:[d]<br>Passing MCN-BON<br><br>Passing JDA Pool-BON<br><br>From JDA Dam-BON<br><br>Passing TDA-BON<br><br>Passing BON Dam | <br>55.4%<br>(24.3% to 69.8%)<br>62.5%<br>(32.2% to 78.0%)<br>76.5%<br>(45.8% to 93.0%)<br>78.6%<br>(47.0% to 95.5%)<br>87.2%<br>(64.9% to 97.6%) | <br>N/A<br><br>N/A<br><br>N/A<br><br>N/A<br><br>N/A | <br>88.9%<br><br>91.5%<br><br>95.6%<br><br>96.4%<br><br>99.1% |
| LCR Steelhead:[e]<br>Passing BON Dam<br><br>Below BON Dam | <br>87.2%<br>(64.9% to 97.6%)<br>N/A | <br>N/A<br><br>N/A | <br>99.1%<br><br>N/A |
| UWR Steelhead | N/A | N/A | N/A |
| CR Chum | N/A | N/A | N/A |
| SR Sockeye | N/A | N/A | N/A |
| LCR Coho[f] | 90.9%<br>(85.0% to 94.1%) | N/A | 95.5% |

[a] The estimated juvenile in-river survival rates shown in this table for transported ESUs are only for those fish that remain in-river for their entire juvenile migration and are not transported.

[b] Estimated juvenile survival rates for LCR (fall) chinook salmon are based on per-project survival rate of SR fall chinook salmon.

[c] Estimated juvenile survival rates for LCR (spring) chinook salmon are based on per-project survival rate of SR spring/summer chinook salmon.

[d] Estimated juvenile survival rates for MCR steelhead are based on per-project survival rate of SR steelhead.

[e] Estimated juvenile survival rates for LCR steelhead are based on per-project survival rate of SR steelhead.

[f] Estimated juvenile survival rates for LCR coho salmon are based on per-project survival rate of SR spring chinook salmon.

| ESU | Estimated Juvenile In-river Survival Rate | Estimated Juvenile System Survival Rate (including transport latent effects) | Estimated Free-Flowing River Survival Rate[h] |
|---|---|---|---|

g Applies only to subyearling life history strategy. An unknown proportion of fish with yearling strategy will have survival rates more closely resembling those of SR spring/summer chinook.
h Free-flowing river survival rates shown are estimated for migration under pre-project conditions based on survival rates in un-impounded river reaches per methods outlined in Ferguson (2004) and Smith (2004).

## 5.4 ESU-Specific Factors Affecting Survival in the Action Area

### 5.4.1 Snake River Spring/Summer Chinook Salmon

#### 5.4.1.1 Juvenile Migrants

Juvenile SR spring/summer chinook salmon are yearling migrants, with downstream movement during April through June. Although yearling chinook salmon move relatively quickly through the mainstem FCRPS projects, they have biological requirements for cover and shelter to provide refuge from predators. NMFS has demonstrated a strong and consistent relationship between travel time through the migratory corridor and flow for spring migrants below McNary Dam, where northern pikeminnow predation rates are particularly high (NMFS 2000b). By decreasing the residence time of yearling smolts in the lower river, higher spring flows may reduce exposure time to predators.

NMFS is uncertain to what extent yearling migrants have a biological requirement for food in the juvenile migration corridor. Whether the abundance or composition of the potential prey assemblage is enhanced or adversely affected by the existence or operation of the FCRPS reservoirs is also unknown.

Spring migrants may also experience competition from out-of-ESU hatchery smolts moving through the system during the same period. Hatchery fish can also act as vectors for disease transmission in the hydro project bypass and juvenile transport systems.

By emigrating during April through June, juvenile SR spring/summer chinook salmon are susceptible to elevated TDG concentrations in the migratory corridor caused by involuntary spill at FCRPS dams and/or Idaho Power Company’s Hells Canyon Dam during high-flow years. As described in Section 5.3.3.2, under the 50-year simulated hydrology for the reference operation, the spill cap at Lower Granite Dam would be exceeded on a monthly average basis as follows: March, 1 out of 50; April, 2 out of 50; May, 12 out of 50; and June, 14 out of 50.

Williams et al. (2004) noted that water temperature begins to adversely affect spring migrant survival in the Snake and Columbia Rivers at about 13°C. Temperature modeling results based on monthly average flows show that water temperatures throughout the migratory corridor for three water conditions (low, average, and high) under the reference operation seldom exceed 13°C during April or May, the peak of the SR spring/summer chinook salmon migration. Water temperatures in excess of 13°C are common during June and may contribute to the poor smolt-to-adult survival seen in late-season migrants.

Because yearling chinook salmon migrate mid-channel through FCRPS reservoirs (Battelle and USGS 2000), they do not have biological requirements for riparian vegetation in the migration corridor. Further, there is no evidence that the change from a free-flowing river to a reservoir environment has resulted in loss of the amount (i.e., quantity) of physical habitat (i.e., space) required by yearling migrants in the migration corridor (Battelle and USGS 2000).

Estimated juvenile in-river survival rates for SR spring/summer chinook salmon in the near-term reference operation for the 10-year SIMPAS simulation period (1994-2003) range from about 44% to over 59% (mean 53%) (Table 5-6). System survival rates, including in-river survival plus survival of transported fish for this ESU range from 48% to over 55% (mean 52.2%) (Table 5-6). System survival includes a differential delayed survival, or D-value, applied to the group of transported fish.

Estimated juvenile in-river survival rates for SR spring/summer chinook salmon in the long-term environmental baseline range from about 49% to nearly 65% (mean 58%) (Table 5-7). System survival rates, including in-river survival plus transported fish survival, range from almost 50% to over 57% (mean 53.5%). This includes a differential delayed mortality, or D-value, applied to the group of transported fish.

These estimates are lower than estimated survival through free-flowing river sections (Tables 5-6 and 5-7). The estimated mean survival under free-flowing conditions for the simulation period (1995-2003) is 78.6% (Ferguson 2004). This indicates that a significant portion of the mortality of juvenile SR spring/summer chinook salmon can be attributed to the existence and operation of FCRPS dams and reservoirs. Because free-flowing river survival rates are assumed to approximate the survival rate associated with properly functioning habitat conditions (Section 1.2.2.2), the lower survival rates estimated under the reference operation indicate that the biological requirements of juvenile SR spring/summer chinook salmon are not being met within the action area.

#### 5.4.1.2 Adult Migrants

Adult SR spring/summer chinook salmon pass up to eight mainstem FCRPS dams. When adjusted for harvest, average adult survival through the FCRPS, based on recent radio tracking study data from 1996-1998 and 2000-2002, was estimated to be 84.6%, with a per-project survival rate of 97.9% (NMFS 2004a). As described in Section 5.3.9.2, this survival rate appears similar to that which would be expected under free-flowing river conditions. Therefore, it is likely that the biological requirements associated with adult migration through the action area have been met in the environmental baseline.

### 5.4.2 Snake River Fall Chinook Salmon

#### 5.4.2.1 Juvenile Migrants

Recent evidence suggests that SR fall chinook salmon follow both a subyearling and yearling migration strategy (Connor et al. 2004). Although the yearling life-history strategy is exhibited by a small number of juveniles, data from PIT-tagged returning adults suggests that up to 40% of returning SR fall chinook adults spent at least one winter in fresh water. Very little is known about yearling SR fall chinook juveniles; their inland rearing locations, habitat preferences, or limiting factors. However, given the apparent strength of this life-history in the population, they are of considerable interest and the subject of ongoing research.

Most juvenile SR fall chinook salmon are subyearling migrants, moving downstream during June through September and rearing during at least part of this period. High water temperatures are observed system-wide during summer and early fall and the survival of juvenile fall chinook salmon through Lower Granite Reservoir may be reduced by an interaction between the thermal effects of USBR's project operations in the Upper Snake Basin, Idaho Power Company's operations at its Hells Canyon Complex, and other actions.

Subyearling fall chinook salmon in the lower Snake River reservoirs are either pelagic-oriented or found over sandy, mostly unvegetated substrate. It is uncertain whether subyearlings have biological requirements for cover, shelter, and vegetation (beyond the potential effect of mainstem flow as a refuge from predation). Although the prey resources available to subyearling SR fall chinook salmon in mainstem reservoirs are different than those in free-flowing reaches (e.g., terrestrial insects and zooplankton dominate in reservoirs versus aquatic insects in a free-flowing river), NMFS is uncertain whether this change enhances or adversely affects biological requirements for food during the outmigration. Similarly, water level fluctuations associated with reservoir operations could disrupt the life cycles of invertebrate prey in the littoral zone, but the Corps operates the lower Snake River pools within one foot of minimum operating pool, minimizing effects on shallow water habitat.

The existence of Snake River FCRPS reservoirs contributes to a shift in the temperature regime of the Snake River by delaying cooling into mid-September due to the large volumes of impounded warm water. Adults entering the Snake River during this period can be delayed by elevated water temperatures, potentially reducing fish condition and reproductive success during spawning. Fall chinook salmon are known to spawn in the tailraces of Lower Granite, Little Goose, and Ice Harbor Dams. According to McCullough (1999), spawning may be inhibited at temperatures above 61°F (16°C). The effects of flow management on the use of mainstem spawning habitat (water quantity and velocity, space, access to habitat, and availability of suitable substrate) are unknown.

Survival of PIT-tagged juvenile fall chinook salmon from release points in the Snake and Clearwater Rivers to Lower Granite Dam is strongly correlated with water temperature, as well as flow and turbidity, in Lower Granite Reservoir (Williams et al. 2004). To minimize water temperature-related effects on juvenile and adult fall chinook salmon, Dworshak Dam on the North Fork Clearwater, about 2 river miles upstream of the Clearwater River, and 60 miles from Lower Granite Reservoir, is routinely operated to release large amounts of cool water during the months of July, August, and early September to reduce water temperatures in Lower Granite Reservoir and downstream reaches to try to achieve State of Washington water temperature standard of 20 C. Dworshak Reservoir is a deep impoundment (over 600 feet at full pool) that stratifies in the summer, and Dworshak Dam is equipped with a variable-intake depth-release structure that facilitates selecting a specific discharge water temperature. During July, August and in recent years into September, reservoir managers typically release water between 7° to 10°C (45° to 50°F) at the request of regional salmon managers. This operation reduces ambient water temperature by about (2° to 3°C) (4° to 6°F) at Lower Granite Dam when elevated temperatures are a concern in the Snake River (July through mid-September). This operation is included in the 2004 FCRPS UPA and is part of the environmental baseline (reference operation) for this consultation.

Estimated juvenile in-river survival rates for SR fall chinook salmon in the near-term reference operation range from 3% to almost 22%, with a mean of about 13% (Table 5-6).

Estimated juvenile in-river survival rates in the long-term reference operation range from over 3% to over 24%, with a mean of about 15% (Table 5-7).

These estimates are lower than estimated survival through the free-flowing river (Tables 5-6 and 5-7). This indicates that a significant portion of the mortality of juvenile SR fall chinook salmon can be attributed to the existence and operation of FCRPS dams and reservoirs. Because free-flowing river survival rates are assumed to approximate the survival rate associated with properly functioning habitat conditions, the lower survival rates estimated under the reference operation indicate that the biological requirements of juveniles have not been fully met in the action area.

#### 5.4.2.2 Adult Migrants

Adult SR fall chinook salmon pass up to eight mainstem dams. When adjusted for harvest, average adult survival is 84.7%, with a per-project survival rate of 98.0% (NMFS 2004a). As described in Section 5.3.9.2, this survival rate appears similar to that which would be expected under free-flowing river conditions. Therefore, it is likely that biological requirements associated with adult migration through the action area have been met in the environmental baseline.

### 5.4.3 Upper Columbia River Spring Chinook Salmon

#### 5.4.3.1 Juvenile Migrants

Juvenile UCR spring chinook salmon are spring migrants with peak movement past Rock Island Dam in the mid-Columbia reach during late April and May. The status of biological requirements for this ESU related to habitat in the mainstem, estuary, and plume, and potential interactions with out-of-ESU hatchery fish, are assumed to be the same as those discussed for SR spring/summer chinook salmon (Section 5.4.1).

For the near-term reference operation, NMFS estimates that juvenile in-river survival through the lower Columbia River reach ranges from over 52% to 74%, with a mean value of 67.5% (Table 5-6). For the long-term reference operation, estimated juvenile in-river survival through the lower Columbia River reach ranges from 58% to nearly 81%, with a mean value of 73.4% (Table 5-7).

These estimates are lower than estimated survival through the free-flowing river (see Tables 5-6 and 5-7). The updated estimate of the mean free-flowing river survival is 85.5% (Smith 2004). This indicates that a significant portion of the mortality of UCR spring chinook salmon can be attributed to the existence and operation of FCRPS dams and reservoirs. Because free-flowing river survival rates are assumed to approximate the survival rate associated with properly functioning habitat conditions (see Section 1.2.2.2), the lower survival rates estimated under the reference operation indicate that the biological requirements of UCR spring chinook salmon juveniles have not been fully met in the action area.

#### 5.4.3.2 Adult Migrants

Average adult survival estimated from recent (2000-2002) radio-tracking studies is 92.0%, with a per-project survival rate of 97.9% (NMFS 2004a). As described in Section 5.3.9.2, this survival rate appears similar to that which would be expected under free-flowing river conditions. Therefore, it is likely that the biological requirements associated with adult migration through the action area have been met in the environmental baseline.

### 5.4.4 Upper Willamette River Chinook Salmon

#### 5.4.4.1 Juvenile Migrants

Juvenile UWR chinook salmon migrate through the mainstem lower Columbia River primarily as yearlings, although subyearlings migrants from this ESU are also moderately common (Fresh et al. 2004). Juvenile UWR chinook salmon enter the action area at the mouth of the Willamette River, at about RM 100 in the lower Columbia River. Most of the migration moves through the lower Columbia River during February through May, before peak spring runoff and periods of involuntary spill. The primary factors affecting the status of this ESU as juveniles move through the estuary and plume have varied with life history strategy. Flow and avian predation are limiting factors for yearlings (Sections 5.3.2 and 5.3.4). Fingerling smolts have a relatively long residence time in the estuary and rely extensively on shallow water habitats to provide both food for high growth rates and shelter from predators (Fresh et al. 2004). Thus, the primary estuarine limiting factors for subyearlings have been flow and the associated reduction in the amount of and access to shallow water habitat. It is not known whether the biological requirements for UWR chinook salmon juveniles are being met in the action area.

#### 5.4.4.2 Adult Migrants

Adult survival through the action area is unknown. However UWR chinook salmon do not pass any FCRPS dams and traverse only the lowermost 100 miles of the Columbia River before entering the Willamette River. It is likely that the biological requirements associated with adult migration through the action area have been met in the environmental baseline.

### 5.4.5 Lower Columbia River Chinook Salmon

#### 5.4.5.1 Juvenile Migrants

Most LCR chinook salmon populations are fall run and produce primarily subyearling migrants. Subyearlings move through the mainstem lower Columbia River during spring and early summer. Only the subyearlings that emerge from the Wind, Little White Salmon, and [Big] White Salmon Rivers in Washington and the Hood River in Oregon would encounter Bonneville Dam after entering the Columbia River. NMFS does not know of any empirical information on the survival of small subyearling migrants at Bonneville Dam. Experiments conducted with juvenile SR fall chinook salmon would not apply directly, because those fish are much larger by the time they reach Bonneville Dam (Section 5.4.2).

Estimated juvenile in-river survival rates for LCR chinook salmon in the near-term reference operation range from 85% to 93% (mean of over 90%) for yearling LCR chinook salmon and 82% to 97% (mean of 86%) for subyearling LCR chinook salmon.

Estimated juvenile in-river survival rates for LCR chinook salmon in the long-term reference operation range from 85% to 94% (mean of about 91%) for yearling LCR chinook salmon and 82% to 97% (mean of 86%) for subyearling LCR chinook salmon.

These estimates are lower than the estimated survival through free-flowing river reaches (see Tables 5-6 and 5-7). The updated estimate of the mean free-flowing river survival for yearling LCR chinook salmon is 98% and for subyearling LCR chinook salmon over 95% (Ferguson 2004). Because survival through free-flowing river sections is assumed to approximate the survival rate associated with properly functioning habitat conditions, the lower survival rates estimated under the reference operation indicate that the biological requirements of juveniles have not been fully met in the action area.

Small subyearling migrants are likely to have biological requirements for food in the mainstem Columbia River migration corridor, but NMFS is uncertain whether the abundance or composition of the prey assemblage is enhanced or adversely affected by hydro operations. Smolts from this ESU are generally small (fry and fingerlings), have long residence times in the estuary and rely extensively on shallow-water habitats to provide both food for high growth rates and shelter from predators (Section 5.3.1). The primary estuarine limiting factors have been flow and the associated reduction in amount of and access to shallow water habitat.

Three spring-run populations (Hood, Kalama, and Sandy Rivers) produce yearling migrants, and juveniles emerging from the Hood River pass Bonneville Dam on their way downstream. NMFS assumes that the survival of yearling smolts emerging from the Hood River and the biological requirements of smolts from all three populations are similar to those of yearling SR spring/summer chinook salmon in the same portion of the action area.

Biological requirements of adults for water quality, quantity, and velocity in the mainstem Columbia River migration corridor are different for the spring- and fall-run components of this ESU. For spring-run chinook salmon, effects are similar to those described above for SR spring/summer chinook salmon (Section 5.4.1). For fall-run fish returning to Upper Gorge spawning areas, low flows during late summer and early fall, related to high temperatures, may delay migration through the Bonneville pool and potentially lead to disease transmission between adults delayed in fish ladders.

Past FCRPS hydropower operations have affected the quantity and quality of, and access to, spawning habitat in the Ives Island area below Bonneville Dam, where several early fall-run chinook salmon from the LCR ESU were observed spawning during October 1999. The environmental baseline includes spill operations at Bonneville Dam, such as spill for juvenile fish passage, debris removal, or gas generation/abatement testing, which could create TDG concentrations high enough to kill yolk sac fry in redds in the Ives Island area. However, this effect is prevented in the environmental baseline by providing flows that create a compensation depth over the redds and/or by reducing the effective TDG concentration to 105% of saturation or less. Flow fluctuations can strand subyearling migrants, making them vulnerable to desiccation or avian predation.

Thus, in the environmental baseline, both flow and spill operations at Bonneville Dam are assumed to be managed to protect chum salmon pursuant to the 2004 FCRPS UPA. Beginning about November 1, the Action Agencies have, since 1999, provided some operations to maintain minimum tailwater elevations below Bonneville Dam to establish and protect redds, although the extent of these operations has depended on the hydrologic forecasts and the ability to implement other seasonal operations. Efforts have also been made to limit spill at Bonneville Dam to a level that would avoid exceeding 105% TDG concentration over established redds. These efforts to protect chum salmon, which are assumed to continue in the environmental baseline, would also confer protection on established LCR chinook salmon redds and emergent fry below Bonneville Dam.

#### 5.4.5.2 Adult Migrants

Average adult survival past Bonneville Dam estimated from recent (1996-1998 and 2000-2002) adult survival radio-tracking study data, based on SR spring/summer and SR fall chinook salmon per project survival rates, ranges from 98.0%-97.4% (NMFS 2004a). As described in Section 5.3.9.2, this survival rate appears similar to that which would be expected under free-flowing river conditions. Therefore, it is likely that the biological requirements associated with adult migration have been met in the environmental baseline.

### 5.4.6 Snake River Steelhead

#### 5.4.6.1 Juvenile Migrants

Juvenile SR steelhead migrate as yearlings, with peak movement past Lower Granite Dam during April and May. Using the SIMPAS model, NMFS has estimated that a range of between 74%-77% of the run starting at the head of Lower Granite pool was transported from the Snake River collector projects in the near-term and long-term reference operation (Appendix A). The direct survival of transported juveniles over the same period was at least 98%, and the average system survival rate shown in Table 5-6 of in-river migrants (which migrate past eight mainstem FCRPS projects) in the near-term reference operation ranged from about 8% up to 46%, with a mean survival of about 35%. From Table 5-6, the total (transported plus in-river) system survival rate for SR steelhead in the near-term reference operation ranged from nearly 43% to almost 55%, with a mean value of 50%, including differential delayed mortality of transported fish assumed in the analysis. The status of habitat that provides biological requirements in the juvenile migration corridor (e.g., water quality, food) is very similar to that described for SR spring/summer chinook salmon (Section 5.4.1.1).

For the long-term reference operation, the average in-river survival rate for passage through the FCRPS (for those fish which migrate past eight mainstem FCRPS projects) shown in Table 5-7 ranged from 9% up to nearly 51%, with a mean survival of 38%. These survival estimates do not include possible effects of latent mortality for in-river migrants. From Table 5-7, the total (transported plus in-river) system survival rate for SR steelhead under the long-term reference operation ranged from 43% to almost 55%, with a mean value of over 50%, including differential delayed mortality of transported fish.

These estimates are lower than the estimated survival through free-flowing river sections (see Tables 5-6 and 5-7). The updated estimate of the mean free-flowing survival from 1995-2003 data is roughly 82% (Ferguson 2004). This indicates that a significant portion of the mortality of SR steelhead can be attributed to the existence and operation of FCRPS dams and reservoirs. Because free-flowing river survival rates are assumed to approximate the survival rate associated with properly functioning habitat conditions, the lower survival rates estimated under the reference operation indicate that biological requirements of juveniles have not been fully met in recent water conditions and would not be fully met under the environmental baseline.

#### 5.4.6.2 Adult Migrants

Based on radio-tracking studies of SR steelhead in 1996-97 and 2001-02, the minimum mean survival rate of adult migrants between Bonneville and Lower Granite Dams is 83.3%, equivalent to a per-project survival rate of 97.7% (NMFS 2004a). As described in Section 5.3.9.2, this survival rate appears similar to that which would be expected under free-flowing river conditions. Therefore, it is likely that the biological requirements associated with adult migration through the action area have been met in the environmental baseline.

Few downstream-migrating adult steelhead (kelts) survive to spawn a second time without passing through dams (7% to lower Columbia River tributaries). However, recent studies have shown an increasing percentage of kelts (34.4% in 2003) surviving to below Bonneville Dam with provision of flows, spills, and sluiceway operation at mainstem FCRPS projects (Boggs and Peery 2004).

### 5.4.7 Upper Columbia River Steelhead

#### 5.4.7.1 Juvenile Migrants

Juvenile UCR steelhead are yearling migrants, moving through the mainstem Columbia River during the spring. The status of biological requirements for this ESU related to mainstem habitat and in the estuary and plume, and potential interactions with out-of-ESU hatchery fish, are the same as those discussed for SR spring/summer chinook salmon (Section 5.4.1). The status of biological requirements for water quality, quantity, and velocity in adult migration corridors is also the same as those discussed for SR spring/summer chinook salmon (Section 5.4.1).

In-river survival of juvenile UCR steelhead migrating through the lower Columbia River reach in the near-term reference operation ranged from over 22% to nearly 65% under 1994-2003 runoff conditions, with a mean of about 51% (Table 5-6). In-river survival of juvenile UCR steelhead in the long-term reference operation ranged from over 24% to nearly 70% under 1994-2003 runoff conditions, with a mean of over 55% (Table 5-7).

These estimates are lower than estimated survival through free-flowing river sections, which is assumed to approximate the survival rate associated with properly functioning habitat conditions. The updated estimate in Tables 5-6 and 5-7 of the mean free-flowing river survival using 1995-2003 data is nearly 88% (Smith 2004). This indicates that a significant portion of the mortality of UCR steelhead can be attributed to the existence and operation of FCRPS dams and reservoirs. Because free-flowing river survival rates are assumed to approximate the survival rates associated with properly functioning habitat conditions, the lower survival rates estimated under the reference operation indicate that the biological requirements of juveniles are not being fully met in the action area.

#### 5.4.7.2 Adult Migrants

Average adult survival based on recent (2001-2002) radio-tracking studies is estimated at 94.1%, with a per project survival rate of over 98.5% (NMFS 2004a). As described in Section 5.3.9.2, this survival rate appears similar to that which would be expected under free-flowing river conditions. Therefore, it is likely that the biological requirements associated with adult migration through the action area have been met in the environmental baseline.

### 5.4.8 Mid-Columbia River Steelhead

#### 5.4.8.1 Juvenile Migrants

Juvenile MCR steelhead are yearling migrants, moving through the mainstem lower Columbia River during spring. Depending upon their natal tributary, smolts from this ESU pass one to four FCRPS projects in the lower Columbia River. The status of biological requirements for this ESU related to habitat in the mainstem, estuary, and plume, and potential interactions with out-of-ESU hatchery fish, are discussed for SR spring/summer chinook salmon (Section 5.4.1). The status of biological requirements for water quality, quantity, and velocity in adult migration corridors is also the same as those discussed for SR spring/summer chinook salmon (Section 5.4.1).

Smith (2004) estimated the free-flowing survival from 1995-2003 to range from about 89%-99%, depending upon the number of lower Columbia River Federal dams each population passes (Tables 5-6 and 5-7). The estimated in-river survival in both the near-term and long-term reference operations for each population of MCR steelhead (Tables 5-8 and 5-9) indicate that a significant portion of the mortality of MCR steelhead can be attributed to the existence and operation of FCRPS dams and reservoirs. Because free-flowing river survival rates are assumed to approximate the survival rates associated with properly functioning habitat conditions, the lower survival rates estimated under the reference operation indicate that the biological requirements of juveniles are not being fully met in the action area.

**Table 5-8.** Estimates of in-river survival for juvenile MCR steelhead in the near-term reference operation (derived from Table 5-6 and Appendix A).

| Major Population Group – Population (No. FCRPS Projects passed) | Range (percent) | Mean (percent) |
|---|---|---|
| Yakima River – Satus and Toppenish creeks, Naches River, and Upper Yakima River (4 FCRPS projects) | 22-65 | 51 |
| Walla Walla and Umatilla rivers – Touchet River and Walla Walla River (4 FCRPS projects including John Day pool) | 22-65 | 51 |
| Rock Creek (3 FCRPS projects) | 31-74 | 60 |
| Walla Walla and Umatilla rivers – Umatilla River (3 FCRPS projects including John Day pool) | 31-74 | 60 |
| John Day River – Upper Mainstem John Day River, South Fork John Day River, Middle Fork John Day River, North Fork John Day River, and Lower Mainstem John Day River (3 FCRPS projects, not including John Day pool) | 44-90 | 73 |
| Cascade Eastern Slope – Deschutes River Westside Tributaries and Deschutes River Eastside Tributaries (2 FCRPS projects) | 46-93 | 76 |
| Cascade Eastern Slope – Fifteen Mile Creek and Klickitat River (1 FCRPS project) | 65-97 | 86 |

**Table 5-9.** Estimates of in-river survival for juvenile MCR steelhead in the long-term reference operation (derived from Table 5-7 and Appendix A).

| Major Population Group – Population (No. FCRPS Projects passed) | Range (percent) | Mean (percent) |
|---|---|---|
| Yakima River – Satus and Toppenish creeks, Naches River, and Upper Yakima River (4 FCRPS projects) | 24-70 | 55 |
| Walla Walla and Umatilla rivers – Touchet River and Walla Walla River (4 FCRPS projects including John Day pool) | 24-70 | 55 |
| Rock Creek (3 FCRPS projects) | 32-78 | 62 |
| Walla Walla and Umatilla rivers – Umatilla River (3 FCRPS projects including John Day pool) | 32-78 | 62 |
| John Day River – Upper Mainstem John Day River, South Fork John Day River, Middle Fork John Day River, North Fork John Day River, and Lower Mainstem John Day River (3 FCRPS projects, not including John Day pool) | 46-93 | 76 |
| Cascade Eastern Slope – Deschutes River Westside Tributaries and Deschutes River Eastside Tributaries (2 FCRPS projects) | 47-95 | 79 |
| Cascade Eastern Slope – Fifteen Mile Creek and Klickitat River (1 FCRPS project) | 65-98 | 87 |

#### 5.4.8.2 Adult Migrants

Average adult survival ranges from 93%-97%, depending upon the number of dams a population passes, with a per project survival rate based on the adult SR steelhead rate of 97.7% (NMFS 2004a). This survival rate appears similar to that which would be expected under free-flowing river conditions (Section 5.3.9.2). Therefore, it is likely that the biological requirements associated with adult migration through the action area have been met in the environmental baseline.

### 5.4.9 Upper Willamette River Steelhead

#### 5.4.9.1 Juvenile Migrants

Juvenile UWR steelhead migrate as yearlings, entering the action area at the mouth of the Willamette River, at about RM 100 in the lower Columbia River during spring. The primary factors affecting the status of this stream-type ESU as juveniles move through the estuary and plume have been avian predation and flow (Sections 5.3.2 and 5.3.4; Fresh et al. 2004). It is not known whether the biological requirements for UWR steelhead juveniles are being met in the action area.

#### 5.4.9.2 Adult Migrants

The status of biological requirements for water quality, quantity, and velocity in adult migration corridors is similar to those discussed for SR spring/summer chinook salmon (Section 5.4.1.2). Adult survival through the action area is unknown. However, UWR steelhead do not pass any FCRPS dams and traverse only the lowermost 100 miles of the Columbia River before entering the Willamette River. It is likely that the biological requirements associated with adult migration through the action area have been met in the environmental baseline.

### 5.4.10 Lower Columbia River Steelhead

#### 5.4.10.1 Juvenile Migrants

Juvenile LCR steelhead are yearling migrants, moving through the mainstem lower Columbia River and estuary during spring. Depending upon their natal tributary, smolts from this ESU pass one or no FCRPS projects in the lower Columbia River. The status of biological requirements for this ESU related to habitat in the mainstem, estuary, and plume, and potential interactions with out-of-ESU hatchery fish, are similar to those discussed for SR spring/summer chinook salmon (Section 5.4.1). The status of biological requirements for water quality, quantity, and velocity in adult migration corridors is also the same as those discussed for SR spring/summer chinook salmon (Section 5.4.1).

For the Gorge populations of LCR steelhead that pass Bonneville Dam, the estimated juvenile in-river survival rates in the near-term reference operation range from 65% to 97% (mean of over 86%).

Estimated juvenile in-river survival rates for LCR steelhead passing Bonneville Dam under the long-term reference operation range from 65% to nearly 98% (mean of over 87%).

These estimates are lower than the estimated survival through free-flowing river reaches (see Tables 5-6 and 5-7). The updated estimate of the mean free-flowing river survival for yearling LCR steelhead is 99% (Ferguson 2004). Because survival through free-flowing river sections is assumed to approximate the survival rate associated with properly functioning habitat conditions, the lower survival rates estimated under the reference operation indicate that the biological requirements of juveniles have not been fully met in the action area.

#### 5.4.10.2 Adult Migrants

Average adult survival past Bonneville Dam, estimated from recent adult radio-tracking study data, is estimated to be 97.4% (NMFS 2004a). As described in Section 5.3.9.2, this survival rate appears similar to that which would be expected under free-flowing river conditions. Therefore, it is likely that the biological requirements associated with adult migration have been met in the environmental baseline.

### 5.4.11 Columbia River Chum Salmon

Some populations of Columbia River chum salmon spawn and rear in the mainstem Columbia River within the action area for this consultation. Therefore, spawning and rearing habitat conditions, as well as migration habitat conditions, are of interest in this consultation.

#### 5.4.11.1 Juvenile Rearing and Migrating Habitat Conditions

Juvenile CR chum salmon juveniles are subyearling migrants, moving through the mainstem lower Columbia River during late winter and early spring. The status of biological requirements of juvenile chum salmon for water quality in the mainstem migration corridor is the same as those discussed for SR spring/summer chinook salmon (Section 5.4.1). The primary factors affecting the status of this ocean-type ESU as juveniles move through the lower Columbia River have been flow and the associated reduction of shallow-water habitat (Section 5.3.1 and 5.3.2; Fresh et al. 2004). It is likely that, due to shallow water habitat losses and flow reductions in the lower Columbia River, the biological requirements for CR chum salmon juvenile rearing and migration are not being met in the environmental baseline. The 2004 FCRPS UPA (Corps et al. 2004) includes several measures aimed at enhancing CR chum habitats in the action area. As these measures are implemented, it is likely that the biological requirements for CR chum salmon in the action area would improve in the long-term environmental baseline.

#### 5.4.11.2 Adult Spawning and Migrating and Egg Incubation Habitat Conditions

Although chum salmon historically spawned in the lower reaches of several tributaries to the Bonneville pool and along the Washington shoreline, this habitat was inundated by the Bonneville pool in 1938 (Fulton 1970). Spawner surveys since 2000 have seen only one adult chum salmon carcass in this area (Big White Salmon River). Thus, it is possible but unlikely that any year class is affected by project passage. CR chum salmon adults counted in known spawning areas downstream from Bonneville Dam have been highly variable in recent years but suggest a generally increasing trend (FPC 2004).

Water stored in upper Columbia and Snake River FCRPS reservoirs is used during the late fall and winter months to augment mainstem flows and maintain the tailwater elevation below Bonneville Dam to improve access to suitable spawning habitat (space) in the Ives Island area.

In the near-term and long-term reference operation, both flow and spill operations at Bonneville Dam are managed to protect chum salmon. Beginning in late October and continuing through March, operations are provided to maintain minimum tailwater elevations at Bonneville Dam to establish and protect redds, although the extent of these operations depends on the ability to implement other seasonal operations. Efforts are also made to limit spill to a level, and/or provide higher flows for depth compensation, that would avoid exceeding TDG concentrations of 105% saturation over established redds. These efforts to protect chum also confer protection to established LCR chinook salmon redds and emergent fry.

Adult CR chum salmon do not have biological requirements for food, cover, shelter, or riparian vegetation associated with spawning habitat. Reservoir storage and operations do not affect temperatures in the Ives Island area during November and December, when chum salmon spawn. However, given the loss of potential spawning habitat associated with dam construction, it is unlikely that the biological requirements for spawning and incubating CR chum salmon in the action area are being met in the environmental baseline.

### 5.4.12 Snake River Sockeye Salmon

#### 5.4.12.1 Juvenile Migrants

Juvenile SR sockeye salmon are yearling migrants, with peak movement past Lower Granite Dam during May. Although there are no empirical survival data, the primary factors affecting the status of this stream-type ESU, as juveniles move through the estuary and plume, are likely to be avian and cormorant predation and flow (Section 5.3.2 and 5.3.4; Fresh et al. 2004). Due to similarities in the timing and size of fish at migration, NMFS assumes that survival rates for SR sockeye would range between those estimates described for SR spring/summer chinook salmon and SR steelhead (Section 5.4.1 and 5.4.6), which are used to characterize effects on this ESU.

#### 5.4.12.2 Adult Migrants

Average adult survival rate through the mainstem FCRPS projects is estimated to be 83% (NMFS 2004a).

### 5.4.13 Lower Columbia River Coho Salmon

#### 5.4.13.1 Juvenile Migrants

Lower Columbia River coho salmon migrate through the lower mainstem Columbia River both as yearling and subyearlings. The primary factors affecting the status of this ESU as juveniles move through the estuary and plume have varied with life history strategy (Fresh et al. 2004).

NMFS is unaware of any empirical information on survival through the Bonneville Dam and pool for this ESU. However, assuming that coho salmon juvenile survival is similar to that demonstrated by yearling LCR chinook salmon juveniles, survival past Bonneville Dam in the near-term reference operation is estimated to range from 85%-93%, with a mean survival of over 90% (Table 5-6). For the long-term reference operation, survival is estimated to range from 85%-94%, with a mean survival of about 91% (Table 5-7). This estimated survival rate is lower than the estimated survival through a free-flowing river. Ferguson (2004) estimated the free-flowing survival to be over 98% for yearling LCR chinook salmon (Tables 5-6 and 5-7). These estimates indicate that the biological requirements of juvenile LCR coho salmon in the reference operation are not being met in the action area.

#### 5.4.13.2 Adult Migrants

The recent (2001-2002) adult survival estimate, based on SR fall chinook salmon per project survival rates, is 98.0% passing Bonneville Dam (NMFS 2004a).

# 6. EFFECTS OF THE PROPOSED ACTION

## 6.1 Introduction and Methods

Effects of the action are defined as "the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with the action, that will be added to the environmental baseline" (50 CFR 402.02). When project operations directly or immediately injure or kill fish or damage habitat at or near the project site, those are considered direct effects of the project. Indirect effects are defined in 50 CFR 402.02 as "those that are caused by the Proposed Action and are later in time, but still are reasonably certain to occur." They include the effects on listed species of future activities that are induced by the PA and that occur after the action is completed. "Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration" (50 CFR 402.02).

The approach to evaluating effects of the PA is summarized in Section 1.2 and detailed in Appendix A. NMFS quantified the effect of the PA by estimating the survival difference between the PA and the environmental baseline, represented by the reference operation (Section 5.2.1.1). For this Opinion, the primary measure of effect is the difference in survival of listed salmon and steelhead ESUs attributable to the difference in flow between the reference operation and the USBR's PA.

NMFS conducted two related analyses, one to inform the jeopardy determination and one to inform the critical habitat determination. For the jeopardy analysis, as discussed in Section 1, NMFS first determines whether the PA is likely to reduce the abundance, productivity, or distribution of a listed ESU. If so, then NMFS determines if that reduction constitutes an "appreciable reduction in the likelihood of both survival and recovery," and therefore is likely to jeopardize the continued existence of the ESU.

For the critical habitat analysis, NMFS applied two alternative analyses. The first, the Environmental Baseline Approach, evaluates the effect of the PA on component areas of designated critical habitat and, in particular, on the essential features of that critical habitat by comparing the conditions of the habitat with and without the PA. If NMFS finds any alteration from the environmental baseline caused by the PA, NMFS would then determine whether the modification adversely modifies any of those essential features.

In the second analysis, the Listing Conditions Approach, NMFS compares the conditions of the essential features of critical habitat that would exist under the PA with the conditions existing at the time the species was listed. If the PA would negatively alter those conditions from what they were at the time of listing, to the extent that it appreciably diminishes the value of critical habitat for survival and recovery, then NMFS determines whether that alteration is an adverse modification of critical habitat.

For this consultation, the effects of the PA on each ESU and on critical habitat are discussed in Section 6.3, while Section 8 presents NMFS' determinations on whether the effects constitute an appreciable reduction in the likelihood of both survival and recovery and the habitat adverse effects constitute destruction or adverse modification of critical habitat for each ESU.

### 6.1.1 Methods for Evaluating the Effects of USBR's PA

USBR's PA directly affects streamflows and indirectly affects water temperatures and TDG concentrations in the Snake and lower Columbia Rivers. These three physical habitat characteristics affect both fish habitat and fish survival in the action area. Rearing and migrating juveniles are the life stages most affected by changes in mainstem flows and water temperatures. All life stages can be adversely affected by elevated TDG conditions. Juvenile mainstem FCRPS dam- and reservoir-passage survival is considered a primary cause of population declines and juvenile survival effects are the focus of the present analysis. Mainstem spawning and rearing habitat is also affected by changes in flow, water temperature, and TDG. For those ESUs that spawn and rear in the mainstem Snake or Columbia Rivers, NMFS therefore analyzes the PA's effects on those habitat features. Migrating adult survival can be affected by changes in flow (e.g., the incidence of dam passage delay and fallback vary with flow); however, our experience in estimating the effects of flow changes on adult survival conducted for the 2004 FCRPS Biological Opinion (NMFS 2004a, Appendix D, Attachment 4) showed that the effects of much larger flow changes on adult salmonid survival were negligible. For this reason, NMFS did not conduct a detailed analysis of adult survival for this Opinion and assumes those effects to be negligible. It should be noted that sublethal effects of FCRPS dam passage is an area of active research.

As described in Section 5.3.2, changes in flow affect juvenile survival, both directly and indirectly. By storing water in the spring, the PA reduces the magnitude of the spring freshet. This action has both adverse and beneficial effects on fish survival and habitat. The adverse effect is a reduction in mainstem FCRPS dam and reservoir passage survival, particularly for spring migrants that traverse the system in-river (not transported). The beneficial water quality effects are associated with water temperature and TDG effects. Reducing Snake River spring flows at Brownlee Reservoir increases the influence of cooler tributary inflows (e.g., the Salmon and Clearwater Rivers) on downstream water temperatures. Also, reducing the magnitude of the spring freshet also reduces the frequency and magnitude of involuntary spills through the eight mainstem FCRPS projects. When river flows exceed a project powerhouse's hydraulic capacity, the dam is forced to spill (termed "involuntary spill"). High rates of involuntary spill can create adverse TDG conditions in downstream waters. Elevated TDG levels (i.e., above the State of Oregon's or Washington's water quality standard waiver level of 120% in tailraces and 115% in forebays of mainstem FCRPS dams) can adversely affect all life stages of fish. The beneficial effects of reduced spill would occur only in high flow years.

NMFS analyzed the PA's effects on juvenile passage survival using its SIMPAS model, reviewed the results of two water temperature models (Corps 2005; EPA 2005), and reviewed the frequency that spills in excess of those considered "safe" (i.e., unlikely to produce excessive TDG) would occur under both the reference operation and the PA operation.

By reducing the spring freshet, the PA would also affect the size of the Columbia River plume and estuary habitat conditions. The role of these habitats in supporting anadromous fish survival is not well understood and is an area of active investigation. NMFS presents a brief estimate of the PA's effects on these habitats in Section 6.2.1.1.

### 6.1.1.1 Criteria for Evaluating Effects

***Quantitative Criteria:*** In some cases, our approach provides quantitative fish survival estimates (e.g., using the SIMPAS model). In those instances, we present the PA's effects in terms of the relative difference in survival ((proposed action survival rate – reference operation survival rate)/ reference operation survival rate) as a percentage, termed the "survival gap." For this Opinion, we qualified these relative differences as follows: 0% = no effect, >0 and < 0.5% = negligible, > 0.5 and < 1.0% very low, > 1.0 and < 2.0% low, and > 2.0% = medium.

***Qualitative Criteria:*** For those habitat and survival effects we are unable to quantify, we use the following criteria: no change – unlikely to cause fish survival or population change; negligible – unlikely to cause measurable fish survival or population change; small – may cause a measurable fish survival or population change, but unlikely to substantially improve or reduce survival or population size; and substantial – likely to cause a substantial change in fish survival or population size.

### 6.1.1.2 Juvenile Dam and Reservoir Passage Survival – The SIMPAS Model

The SIMPAS model (NMFS 2004a) was used to estimate the dam passage survival rates of juvenile salmon and steelhead through the mainstem FCRPS projects in the action area under both the reference operation (Section 5.2.1.1) and USBR's PA. The difference in juvenile passage survival under these two scenarios is termed the "survival gap," and is the focus of the SIMPAS analysis. SIMPAS quantifies the relative difference in system survival between the reference and PA operations based on dam passage route survival characteristics, juvenile dam passage route distributions, and pool survival conditions (Appendix A). The estimated "hydrosystem" survival is the sum of in-river survival and transportation survival from the point of fish entry into the mainstem migratory corridor to downstream of Bonneville Dam, expressed as a percentage. The system survival gap is the principal measure of the effect of the action on juvenile survival and it includes the differential delayed survival of transported fish.

As in Section 5, for ESUs where empirical data are sparse or lacking, survival estimates were inferred from data available for similar species (e.g., SR sockeye salmon survival rates were inferred from SR spring/summer chinook salmon and SR steelhead).

Due to actions that will be taken to fulfill commitments made in the 2004 FCRPS UPA (Corps et al. 2004), mainstem passage survival rates and essential features of the reference operation are going to change in predictable ways during the first ten years of this Opinion.[17] Because these changes are designed to improve fish survival and may influence the size of the "survival gap," we estimated the effect of the USBR's PA on fish survival during their migration through the FCRPS under both the near-term (from the date this Opinion is issued until all fish survival improvement measures identified in the 2004 FCRPS UPA [Corps et al. 2004] are implemented), and long-term (from the end of the near-term through the period of this Opinion [March 2035]).

[17]On November 30, 2004, NMFS issued a biological opinion to the FCRPS Action Agencies (Corps, BPA, and USBR) on the operation and maintenance of the entire FCRPS through November 2014. The UPA describes the proposed action for that consultation. As a completed consultation, the existing and anticipated characteristics of the FCRPS, as described by the UPA, are part of the environmental baseline for this consultation.

We estimated the survival rates of listed fish that are collected and transported at the juvenile collector projects (Lower Granite, Little Goose, Lower Monumental, and McNary dams) from the point of collection to the point of release downstream from Bonneville Dam, including the delayed effects of transportation (referred to elsewhere as the "D" value). Survival rates are estimated both as absolute differences between the proposed and reference operations and as relative (i.e., proportional) differences.

#### 6.1.1.3 Habitat Assessments

The PA's effects on mainstem spawning habitat and juvenile survival downstream from Bonneville Dam cannot be estimated using SIMPAS. The lower Columbia River and estuary are used by both migrating and juvenile fish of all Columbia River ESUs and the lower Columbia River is also used by LCR fall chinook salmon and CR chum salmon for spawning and rearing. The Snake River reach from Hells Canyon Dam to Asotin, Washington, is the primary spawning area for SR fall chinook salmon. NMFS assessed the extent of effects on spawning, incubation, and juvenile rearing and habitat.

#### 6.1.1.4 Water Quality

NMFS also considered the PA's effects on water temperature and TDG concentrations in the lower Snake and lower Columbia Rivers. These parameters have effects on both juvenile and adult salmon and steelhead survival. The EPA and the Corps modeled water temperature conditions at selected sites in the migratory corridor under flows from both the reference operation and the PA. The EPA developed its RBM-10 model to evaluate the effect of impoundments on the temperature of the Columbia and Snake Rivers (Yearsley 1999) and it is specific to those river systems. The Corps' model, CE-QUAL 2E, is a general water quality model that has recently been calibrated to evaluate the effect of flow on water temperatures in Lower Granite Reservoir. NMFS used the results of both of these modeling efforts in our analysis of water temperature-related survival effects, which involved two approaches.

For spring migrants, the magnitude of monthly average water temperature difference, in the lower Snake and lower Columbia Rivers, between the reference operation and the PA, as well as the frequency that water temperatures would exceed 13°C, were analyzed. Williams et al. (2004) noted that water temperatures above about 13°C begin to adversely affect spring migrant survival. The effect of water temperature on the survival of SR fall chinook salmon subyearling migrants is assessed by applying a survival model developed by Connor (2003). This model accounts for the influence of both flow and water temperature on the survival of juvenile fall chinook salmon. In general, summer water temperatures in excess of the Washington State water quality standard of 20°C reduce the survival of summer migrants.[18]

[18]The EPA recently recommended numerical water temperature criteria for each salmon and steelhead life stage that occurs during summer maximum temperature conditions. These temperature parameters were developed by EPA with the technical assistance of NMFS and the USFWS, the Northwest states, and member Tribes of the Columbia River Inter-Tribal Fish Commission.

For TDG, NMFS compared the frequency that involuntary spills at selected FCRPS projects in the migratory corridor would exceed the gas limits established by the Corps (to avoid exceeding the State gas standard and to avoid adverse TDG conditions in downstream waters) under the PA to those under the reference operation.

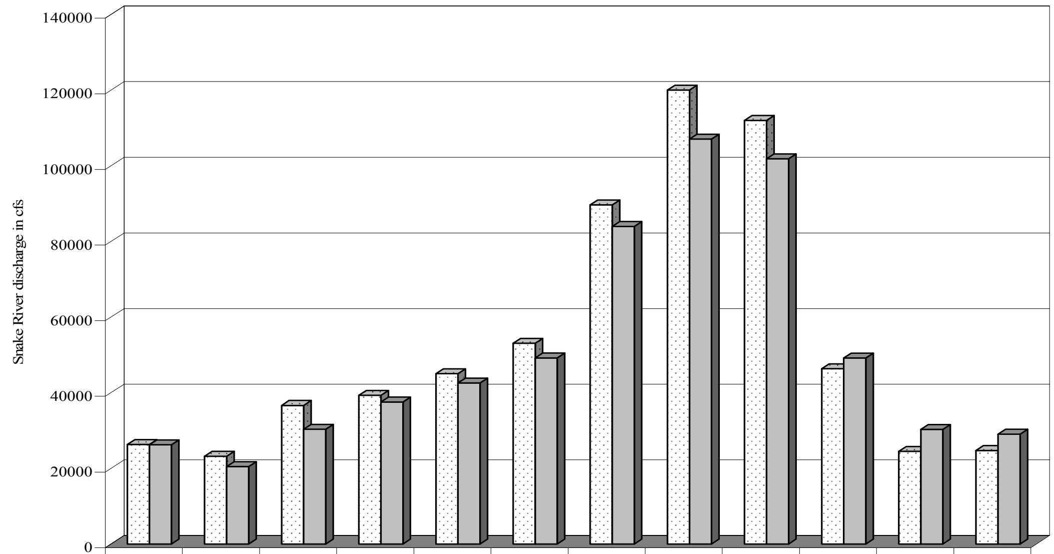
## 6.2 Results Common to Multiple ESUs

### 6.2.1 Snake and Columbia River Flow

Flows modeled at specified locations for both the proposed action and reference operation are shown in Figures 6-1 through 6-3. Within occupied habitats, the relative effect of the proposed action on flow is strongest immediately downstream from Hells Canyon Dam and diminishes with distance downstream from Hells Canyon Dam as local tributaries contribute to mainstem flow. Thus, effects on downstream ESUs, such as the UWR steelhead, are smaller than effects on upstream ESUs, such as SR spring/summer chinook salmon. The proposed action causes a moderate net reduction (8%) in seasonal average spring flows in the Snake River, when SR sockeye salmon, SR spring/summer chinook salmon, and SR steelhead are migrating (Table 6-1). Compared to the reference operation, the proposed action would reduce flows in the lower Columbia River by 2% to 5% during the spring, when juvenile migrants from several ESUs (SR spring/summer chinook salmon; UCR spring chinook salmon; spring-run populations of LCR chinook salmon; UWR chinook salmon; SR,UCR, MCR, LCR, and UWR steelhead; and SR sockeye salmon) are migrating through the action area (Table 6-1). Juvenile CR chum salmon are both rearing and migrating in the action area (mainstem below The Dalles Dam) during the early part of this period. Where data were available, NMFS estimated the fish survival effects of these flow changes in Section 6.3. For some lower Columbia River stocks (i.e., UWR chinook salmon, spring-run LCR chinook salmon, LCR steelhead, and CR chum), the effects of flow changes are not quantifiable because there are no empirical survival data for the reach below Bonneville Dam. Therefore, survival effects on these ESUs are estimated qualitatively.

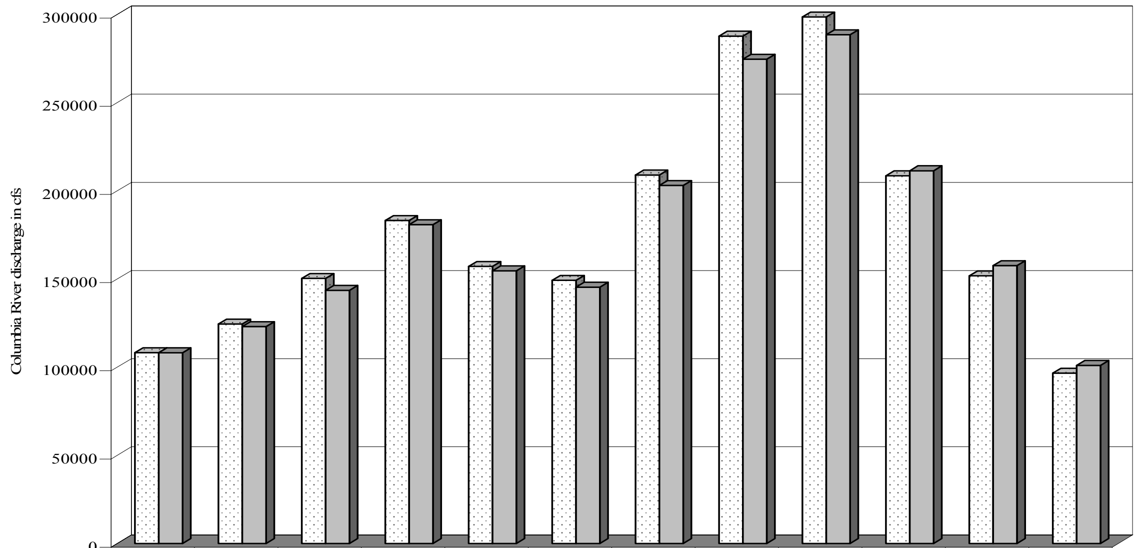
The relative effects of the proposed action on summer flows in the lower Snake River (average increase of 7.5%; range = 0.8 to 13.7%) and in the lower Columbia River (average increase of 2.7%; range = 1.9 to 3.4%) would improve juvenile SR fall chinook salmon dam passage survival and would influence habitat conditions in the Snake and Columbia Rivers. The dam and reservoir passage effects are captured in the SIMPAS analysis for SR fall chinook salmon (Section 6.3.2.2) and the flow- and water-temperature-related effects are discussed in Section 6.3.2.4.

Details of the hydrologic analysis are provided in Appendix A.



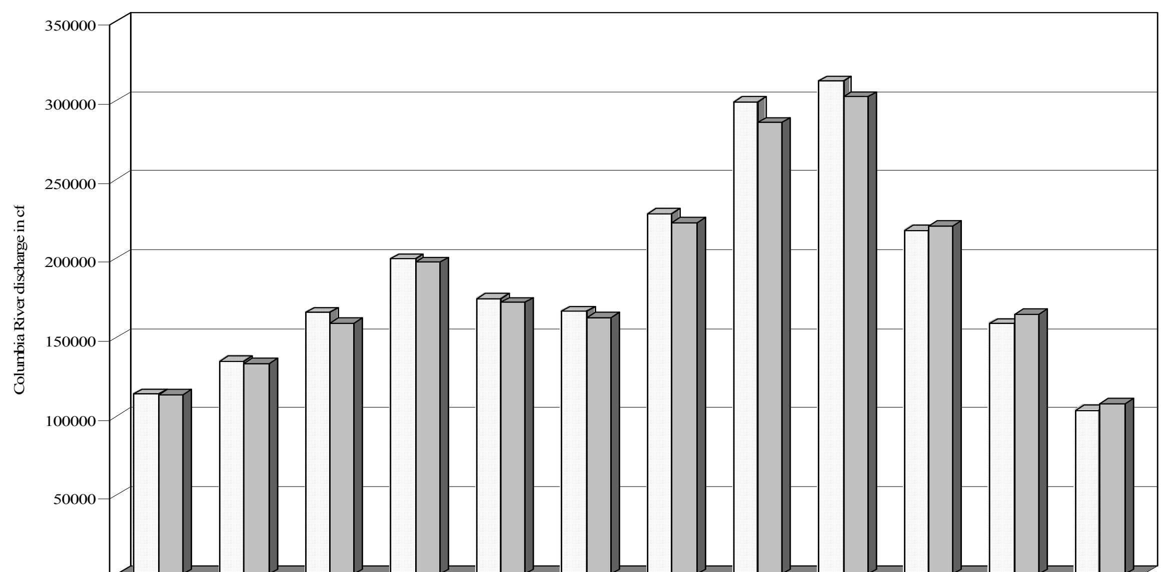

| | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference Operation | 26311 | 23228 | 36651 | 39310 | 45016 | 53049 | 89668 | 120026 | 111983 | 46347 | 24476 | 24748 |
| Proposed Action | 26236 | 20471 | 30342 | 37573 | 42556 | 49206 | 83953 | 107075 | 101870 | 49202 | 30307 | 29060 |

**Figure 6-1.** Mean monthly Snake River discharge (cfs) at Lower Granite Dam under the Proposed Action and under the reference operation over a 50-year simulated hydrologic record (WY 1929-1978). Sources: Reference Operation, BPA HYDSIM Model run USN_BIOP2004_NOIRR; Proposed Action, BPA HYDSIM Model run USN_BIOP2004.




| | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference Operation | 108259 | 124453 | 150265 | 183136 | 157119 | 149192 | 208926 | 287732 | 298624 | 208543 | 151784 | 96600 |
| Proposed Action | 108185 | 123001 | 143582 | 180823 | 154657 | 145349 | 203043 | 274632 | 288511 | 211384 | 157531 | 101014 |

**Figure 6-2.** Mean monthly Columbia River discharge (cfs) at McNary Dam under the proposed action and under the reference operation over a 50-year simulated hydrologic record (WY 1929-1978). Sources: Reference Operation, BPA HYDSIM Model run USN_BIOP2004_NOIRR; Proposed Action, BPA HYDSIM Model run USN_BIOP2004.




| | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference Operation | 113959 | 135173 | 165830 | 199922 | 174482 | 166496 | 228594 | 299117 | 312473 | 217948 | 158899 | 103709 |
| Proposed Action | 113884 | 133720 | 159147 | 197609 | 172021 | 162653 | 222711 | 286017 | 302360 | 220788 | 164645 | 108123 |

**Figure 6-3.** Mean monthly Columbia River discharge (cfs) at Bonneville Dam under the proposed action and under the reference operation over a 50-year simulated hydrologic record (WY 1929-1978). Sources Reference Operation, BPA HYDSIM Model run USN_BIOP2004_NOIRR; Proposed Action, BPA HYDSIM Model run USN_BIOP2004.

**Table 6-1.** Simulated seasonal average flows (and flow ranges) in thousands of cubic feet per second (kcfs) for both the reference and PA operations during key migration and spawning periods in the action area for the years 1994 through 2003. Source: BPA "HYDSIM" model studies: Reference Operation USNBIOP04_NOIIRR, and Proposed Action USNBIOP04.

| Reach – Season | Reference Operation | Proposed Action Operations | Absolute Difference (Proposed - Reference) | Percent Difference (Absolute Difference ÷ Reference) |
|---|---|---|---|---|
| Snake River – Spring (4/3 - 6/20) | 101.7 (50.1 to 161.2) | 93.7 (47.4 to 146.4) | -8.0 (-14.9 to -2.7) | -7.9% (-9.2 to -5.3%) |
| Snake River - Summer (6/21 – 9/30) | 38.9 (22.8 to 59.9) | 41.8 (25.9 to 60.4) | 2.9 (0.5 to 4.4) | 7.5% (0.8 to 13.7%) |
| Lower Columbia -Spring (4/10 – 6/30) | 269.3 (145.0 to 379.0) | 260.9 (142.5 to 361.5) | -8.4 (-17.5 to -2.5) | -3.1% (-4.6 to -1.7%) |
| Lower Columbia – Summer (7/1 - 9/30) | 154.2 (110.7 to 185.6) | 158.3 (114.3 to 189.1) | 4.1 (3.3 to 5.1) | 2.7% (1.9 to 3.4%) |
| Lower Columbia -Fall and Winter (11/1 – 4/15) | 176.0 (130.7 to 212.8) | 166.4 (127.8 to 212.7) | -9.6 (-38.6 to 0.3) | -5.4% (-23.0 to -0.1%) |

Flows downstream from Bonneville Dam would average about 5% lower in the PA than those under the reference operation during the fall and winter, when one population of CR chum salmon is spawning and incubating at several sites within this reach, and where the juveniles of many Columbia Basin ESUs are rearing (Section 6.3).

#### 6.2.1.1 Flow-Related Effects on the Columbia River Estuary and Plume

At NMFS' request, Hyde et al. (2004) evaluated the sensitivity of the amount and distribution of shallow-water rearing habitat in the lower Columbia River (below RM 35) to changes in discharge at Bonneville Dam during the low-discharge period (July through September). This study focused on the sensitivity to changes in discharge in the range of 150-190 kcfs, which brackets the PA and reference operations. Simulations of the circulation patterns observed in the lower Columbia River during 1999-2002 constitute the basis for this analysis. In the lower 35 miles of the Columbia River, changes in operation of the FCRPS hydropower system that result in discharges in the range of 150-190 kcfs appeared to have only slight impacts on the total area of shallow-water habitat available and the hours that shallow water habitat fit the specific depth criteria. Hyde et al. (2004) suggested that this was because the length of time an area was inundated increased with flow and as a function of interaction with the tide. The direction and strength of these impacts varied within the lower estuary.

Due to extensive diking and the effects of tides, Jay et al. (2004) found that the amount of shallow-water habitat in the lower Columbia River varies very little over a much wider range of flow changes than those identified as effects of the PA in this consultation. Thus, the PA's likely effect on juvenile rearing habitats is small to negligible.

The reduction of the spring freshet associated with the PA may have a somewhat larger influence on habitat conditions in the Columbia River plume. Assuming that the PA's effects on the habitat value of the plume roughly equal the relative change in spring discharge, the PA reduces the plume's habitat value by about 3%. As stated in Section 5, the plume's role as salmon and steelhead habitat is poorly understood. However, a 3% reduction in the size of the plume would appear to be a relatively small effect.

### 6.2.2 Water Temperature

By affecting streamflows during the juvenile outmigration season (April through August), the PA measurably affects water temperatures and water temperature-related survival factors. Both EPA (Table 6-2) and the Corps (Table 6-3) modeled daily stream temperatures during low (2000), average (1995), and high (1997) water year conditions. EPA-modeled average monthly water temperature effects (Table 6-2) are generally very small and show that the PA would reduce water temperatures in the spring and have mixed effects during the summer, and the effects diminish downstream.

The Corps modeled temperature effects at Lower Granite Dam only (Table 6-3). Although numerically different than the EPA results, the results show a similar pattern of reduced spring water temperatures and elevated summer (July, August, and September) water temperatures.

Estimated water temperature-related fish survival effects are presented in Section 6.3. Details of these analyses are provided in Appendix A.

**Table 6-2.** Estimated water temperatures (°C) at selected FCRPS dams for low, average, and high flow years under the reference operation and the proposed action and the differences between the two conditions. Source: EPA 2005.

| | **Lower Granite Dam** | | | **Ice Harbor Dam** | | | **McNary Dam** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Month** | **Low 2000** | **Ave 1995** | **High 1997** | **Low 2000** | **Ave 1995** | **High 1997** | **Low 2000** | **Ave 1995** | **High 1997** |
| **REFERENCE OPERATION** | | | | | | | | | |
| April | 9.7 | 8.4 | 8.3 | 9.8 | 8.3 | 8.4 | 8.7 | 8.1 | 7.9 |
| May | 12.5 | 11.5 | 10.9 | 13.2 | 11.9 | 11.4 | 12.2 | 11.9 | 11.6 |
| June | 15.5 | 14.5 | 14.1 | 15.9 | 14.6 | 14.5 | 15.3 | 15.1 | 14.8 |
| July | 18.7 | 18.7 | 19.5 | 21.0 | 20.0 | 19.9 | 20.0 | 19.5 | 18.6 |
| August | 20.2 | 19.2 | 19.6 | 22.7 | 21.5 | 23.0 | 21.6 | 20.0 | 21.5 |
| September | 19.0 | 19.6 | 18.4 | 20.9 | 20.6 | 20.1 | 19.7 | 18.3 | 19.2 |
| **PROPOSED ACTION** | | | | | | | | | |
| April | 9.4 | 8.3 | 8.3 | 9.7 | 8.3 | 8.4 | 8.6 | 8.1 | 7.9 |
| May | 12.2 | 11.4 | 10.5 | 13.0 | 11.8 | 11.2 | 12.2 | 11.9 | 11.5 |
| June | 15.4 | 14.3 | 13.7 | 15.9 | 14.5 | 14.2 | 15.2 | 15.1 | 14.8 |
| July | 19.0 | 18.7 | 19.4 | 20.8 | 20.0 | 19.8 | 20.0 | 19.5 | 18.5 |
| August | 20.4 | 19.5 | 19.7 | 22.6 | 21.4 | 22.7 | 21.6 | 20.0 | 21.5 |
| September | 19.1 | 19.9 | 18.6 | 20.6 | 20.6 | 20.2 | 19.7 | 18.3 | 19.3 |
| **DIFFERENCE (PROPOSED - REFERENCE)** | | | | | | | | | |
| April | -0.3 | -0.1 | 0.0 | -0.1 | 0.0 | 0.0 | -0.1 | 0.0 | 0.0 |
| May | -0.3 | -0.1 | -0.4 | -0.2 | -0.1 | -0.2 | 0.0 | 0.0 | -0.1 |
| June | -0.1 | -0.2 | -0.4 | 0.0 | -0.1 | -0.3 | -0.1 | 0.0 | 0.0 |
| July | 0.3 | 0.0 | -0.1 | -0.2 | 0.0 | -0.1 | 0.0 | 0.0 | -0.1 |
| August | 0.2 | 0.3 | 0.1 | -0.1 | -0.1 | -0.3 | 0.0 | 0.0 | 0.0 |
| September | 0.1 | 0.3 | 0.2 | -0.3 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 |

**Table 6-3.** Estimated water temperatures (°C) at Lower Granite Dam for low, average, and high flow years under the reference operation and the proposed action and the differences between the two conditions. Source: Corps 2005

| | Lower Granite Dam | | |
|---|---|---|---|
| **Month** | **Low 2000** | **Ave 1995** | **High 1997** |
| **REFERENCE OPERATION** | | | |
| May | 11.9 | 11 | 10.1 |
| June | 14.9 | 13.6 | 13.4 |
| July | 17.1 | 16.4 | 18.7 |
| August | 16.8 | 17.1 | 18.2 |
| September | 17.4 | 17.5 | 16.8 |
| **PROPOSED ACTION** | | | |
| May | 11.8 | 11 | 10 |
| June | 14.8 | 13.6 | 13.2 |
| July | 17.5 | 16.5 | 18.7 |
| August | 17.8 | 17.8 | 18.5 |
| September | 17.6 | 17.9 | 17.1 |
| **DIFFERENCE (PROPOSED - REFERENCE)** | | | |
| May | -0.1 | -0.1 | -0.1 |
| June | 0.0 | -0.1 | -0.2 |
| July | 0.4 | 0.2 | 0.0 |
| August | 1.0 | 0.7 | 0.3 |
| September | 0.2 | 0.4 | 0.3 |

#### 6.2.2.1 Spring Water Temperature Survival Effects

To determine whether there was a likely water temperature-related survival effect during the spring migration season (April 3 through June 20), the frequency that modeled mean daily water temperatures at Lower Granite Dam would exceed 13°C (see Section 5.3.3.1) under the reference operation and the PA was assessed (Table 6-4). This analysis suggests that the reduction in spring flows under the proposed action would improve water temperature conditions for spring migrants in the Snake River (e.g., SR spring/summer chinook, SR steelhead). This is due to the warmer water temperatures in the upper Snake River than the major tributaries (e.g., the Salmon and Clearwater Rivers). The lower spring flows from the upper Snake River under the PA results in these tributaries having a stronger influence on water temperatures in the lower Snake River.

**Table 6-4.** Number of days during the spring migration season (April 3 through June 20) that simulated water temperatures exceed 13°C at Lower Granite Dam. Source: EPA 2005 and Corps 2005.

| Year | EPA | | Corps | |
|---|---|---|---|---|
| | **Environmental Baseline** | **Proposed Action** | **Environmental Baseline** | **Proposed Action** |
| **1995** | 17 | 14 | 17 | 16 |
| **1997** | 11 | 10 | 7 | 6 |
| **2000** | 29 | 16 | 23 | 23 |

### 6.2.3 Spill and Total Dissolved Gas Effects

#### 6.2.3.1 Involuntary Spill Effects

By storing water during the spring freshet, the PA would reduce the frequency and magnitude of involuntary spill events at various mainstem FCRPS projects in the migratory corridor. Involuntary spill occurs when inflows exceed a project's powerhouse capacity. High rates of involuntary spill create adverse TDG conditions. HYDSIM modeling results show that involuntary spills would mostly occur in April, May, and June, with rare spill events in March and July (Table 6-5). These months cover the peak of the spring migration (SR sockeye salmon; SR spring/summer chinook salmon; SR,UCR, MCR, LCR, and UWR steelhead; UCR spring chinook; some populations of LCR chinook salmon; CR chum salmon; and UWR chinook salmon) and the period of SR fall chinook rearing.

The reduction in involuntary spill would reduce the frequency that FCRPS project spills would exceed the current gas caps (Corps 2004 Water Management Plan). For example, at Lower Granite Dam, the Corps has set a spill limit of 43,000 cfs to avoid adverse TDG conditions downstream. These gas caps are designed to prevent the generation of TDG concentrations that exceed 120% of the saturation level in project tailraces or 115% of saturation in the forebay of the next downstream project, which are the State water quality gas standard waiver levels. These limits were established to prevent GBT in salmon and steelhead (NMFS 1995a). As saturation TDG concentrations vary with water temperature and barometric pressure, the project-specific gas caps were established to prevent excessive TDG generation over a wide range of background conditions. Compared to the reference operation, the PA would reduce the frequency that spills would exceed the gas caps by 8% (4 years out of 50) in May and June at Lower Granite and Lower Monumental Dams (Table 6-5). Similar benefits would be provided at The Dalles Dam on the Columbia River. These beneficial effects of the PA on excessive involuntary spills would occur primarily in high runoff years when storage in USBR reservoirs would attenuate the spring freshet.

TDG control is an area of active management. Measures to improve spill performance, such as spillway flow deflectors, have been installed at most of the mainstem FCRPS projects, and system performance is continuously being monitored and improved. For this reason, these gas caps may change as system water management and our understanding of gas and spill levels improves, but the relative benefits of the USBR's PA in controlling involuntary spills and adverse TDG conditions, compared to the reference operation, is likely to continue through the life of this Opinion.

**Table 6-5.** Monthly average and maximum involuntary spills (cfs) and the frequency (years per 50) that spills would cause spills in excess of project gas caps at selected FCRPS dams under the environmental baseline (reference operation) and the PA based on HYDSIM models of the two scenarios.

| | | March | April | May | June | July |
|---|---|---|---|---|---|---|
| | | **REFERENCE OPERATION** | | | | |
| **Lower Granite Dam** | Average | 1279 | 9008 | 22137 | 25618 | 290 |
| | Maximum | 60092 | 77568 | 86119 | 123589 | 11906 |
| | Spill >43 kcfs | 1 | 2 | 12 | 14 | 0 |
| | **PROPOSED ACTION** | | | | | |
| | Average | 1401 | 6939 | 13487 | 17470 | 218 |
| | Maximum | 62174 | 70262 | 70213 | 94837 | 9724 |
| | Spill >43 kcfs | 1 | 2 | 8 | 10 | 0 |
| **Lower Monumental Dam** | **REFERENCE OPERATION** | | | | | |
| | Average | 819 | 7195 | 23067 | 18443 | 0 |
| | Maximum | 40929 | 75395 | 87214 | 108233 | 0 |
| | Spill >44 kcfs | 0 | 2 | 13 | 10 | 0 |
| | **PROPOSED ACTION** | | | | | |
| | Average | 859 | 5405 | 13979 | 11634 | 0 |
| | Maximum | 42958 | 67943 | 70918 | 78978 | 0 |
| | Spill >44 kcfs | 0 | 2 | 9 | 6 | 0 |
| **The Dalles Dam** | **REFERENCE OPERATION** | | | | | |
| | Average | 1864 | 15754 | 53062 | 67695 | 6854 |
| | Maximum | 93223 | 132972 | 205694 | 366407 | 66632 |
| | Spill >135 kcfs | 0 | 0 | 8 | 11 | 0 |
| | **PROPOSED ACTION** | | | | | |
| | Average | 1906 | 13905 | 43805 | 58798 | 7052 |
| | Maximum | 95310 | 130164 | 182900 | 358305 | 68066 |
| | Spill >135 kcfs | 0 | 0 | 4 | 9 | 0 |

### 6.2.3.2 Voluntary Spill

The PA would also have very small effects on voluntary spill levels at the FCRPS dams in some years by decreasing total river flows. Voluntary spill is provided at FCRPS mainstem dams to provide a non-turbine avenue for dam passage, which reduces turbine-induced mortality and injury, and reduces dam passage delay. Compared to the reference operation, the PA would cause slight reductions in voluntary spill, primarily in average- and low-flow years, and primarily at FCRPS projects for which the established spill criteria are a percentage of total project discharge (e.g., Lower Monumental, John Day, and The Dalles Dams). Any juvenile dam passage survival effects would be captured by the SIMPAS analysis and included in the ESU-specific survival results presented in Section 6.3.

### 6.2.4 Adult Survival

Passage through the FCRPS has a very low effect on the survival of adult salmon and steelhead (2004 FCRPS Biological Opinion [NMFS 2004a], Section 6.2.2.2). Bjornn et al. (2000) estimated that the median time for adults to transit the lower Snake River in 1993 was the same or less with dams than it would have been without dams, suggesting that adult passage timing is relatively unaffected by the FCRPS. This is due to the faster transit times through project reservoirs than those that would occur in the natural river. This transit time effect is weakly affected by changes in flow (NMFS 2004a).

To pass each dam, adult fish must successfully locate and ascend the project fish ladder(s). The ability to successfully pass each dam has been found to be affected by project configuration and various operating characteristics, principally attraction flow rates, project spill patterns, and powerhouse discharge patterns. High rates of spill have been found to delay project passage, especially those associated with involuntary spill. Compared to the reference operation, the reduction in involuntary spill frequency, magnitude, and duration associated with the PA would slightly reduce adult migration delays. The effect of a small reduction in delay on adult survival or spawning success is unknown but is likely beneficial, particularly at Bonneville Dam, where pinniped predation of adult chinook salmon and steelhead is a growing problem.

By reducing the frequency of spills in excess of the Corps' gas-cap limits, the PA would also benefit migrating adults by reducing the incidence of GBT, although the incidence of GBT in adults tends to be less than in juveniles.

The reduction in involuntary spills in the PA would also reduce the frequency of adult fallback. However, recent review of available data suggests that adult escapement to their spawning grounds is similar under spill and no-spill conditions (NMFS 2004a). Thus, the reduction in involuntary spills under the PA, compared to the reference operation, is not expected to strongly affect adult survival. Overall, the PA's effects on adult survival are expected to be negligible to a small benefit to spring migrants in above average flow years.

It has been noted that incidence of headburn (skin lesions on fish heads) on returning adults is more common during high flow years than during low flow years. While the cause(s) of headburn is unknown, it may be that by reducing high spring flows the PA would reduce the incidence of headburn on return adults.

#### 6.2.4.1 Steelhead Kelts

Most steelhead kelts migrate downstream past mainstem Snake and Columbia River FCRPS dams through spill and sluiceway routes and are known to migrate faster with higher flows (Boggs and Peery 2004). Thus, it is possible that the reduction in spring flows and involuntary spills under the PA, compared to the reference operation, could negatively affect the survival of kelts at those projects. However, information regarding repeat spawning rates suggests that there would be little or no difference in the survival of kelts to returning adults between alternative dam operations. Repeat spawning rates for Snake River Basin steelhead currently, with eight dams in place, average less than 2% (Ferguson et al. 2004). This is approximately the same repeat spawning rate as that observed when only two dams were in place (Whitt 1954 ), suggesting that factors other than dam passage have a more significant effect on kelt survival and repeat spawning. Overall, the PA's effects on kelt survival to repeat spawning are expected to be negligible.

### 6.3 ESU-Specific Effects

The ESU-specific effects of the PA include both the effects on important habitat characteristics in the action area and estimated effects on juvenile and adult fish passage survival.

SIMPAS-estimated juvenile dam and reservoir passage survival is the focus of the survival gap analysis. Tables 6-6 through 6-9 summarize these effects for each ESU that pass through one or more FCRPS projects. Appendix A provides details on how those analyses were conducted and provides the annual system and in-river survival estimates for each ESU. These results are discussed below in the Mainstem Dam and Reservoir Passage Survival sections for each ESU.

**Table 6-6.** Estimated average juvenile and adult survival rates over 1994-2003 water years through the FCRPS in its near-term configuration under the USBR's proposed action. These estimates do not include possible post-Bonneville latent mortality of in-river migrants (Appendix A). Source: NMFS staff.

| ESU | Estimated Juvenile In-river Survival Rate | Estimated Juvenile System Survival Rate (including transport latent effects) | Estimated Adult Survival Rate[19] |
|---|---|---|---|
| SR Spring/Summer Chinook Salmon[3] | 52.5% (44.1% to 59.0%) | 52.2% (47.7% to 55.1%) | 84.6% (75.0% to 93.6%) |
| SR Fall Chinook Salmon,[20] | 14.3% (6.1% to 21.7%) 5.5 in-river fish per 1000 @ LGR pool alive below BON (2.1-9.5) | N/A | 84.7% (80.0% to 92.3%) |
| UCR Spring Chinook Salmon | 67.4% (52.7% to 73.8%) | N/A | 92.0% (91.1% to 93.5%) |
| LCR Chinook: | | | |
| Gorge Fall MPGs[21] | 86.1% (78.3% to 97.3%) | N/A | 98.0% (no range avail.) |
| Gorge Spring MPGs[22] | 90.1% (84.7% to 92.8%) | N/A | 96.5% (no range avail.) |
| Below BON Dam MPGs | N/A | N/A | N/A |
| UWR Chinook Salmon | N/A | N/A | N/A |
| SR Steelhead[4] | 33.5% (7.4% to 45.9%) | 49.8% (41.9% to 53.3%) | 83.3% (75.0% to 89.9%) |
| UCR Steelhead | 50.7% (22.1% to 64.3%) | N/A | 94.1% (92.2% to 96.1%) |
| MCR Steelhead:[23] | | | |
| Passing MCN-BON | 50.7% (22.1% to 64.3%) | N/A | 91.1% (no range avail.) |
| Passing JDA Pool -BON | 59.2% (30.3% to 74.3%) | N/A | 93.3% (no range avail.) |
| From JDA Dam-BON | 72.9% (43.5% to 89.8%) | N/A | 93.3% (no range avail.) |
| Passing TDA-BON | 75.8% (45.2% to 93.3%) | N/A | 95.4% (no range avail.) |
| Passing BON Dam | 86.1% (64.2% to 97.4%) | N/A | 97.7% (no range avail.) |
| LCR Steelhead:[24] | | | |
| Passing BON Dam | 86.1% (64.2% to 97.4%) | N/A | 97.4% (no range avail.) |
| Below BON Dam | N/A | N/A | N/A |
| UWR Steelhead | N/A | N/A | N/A |
| CR Chum | N/A | N/A | N/A |
| SR Sockeye | N/A | N/A | 83.1% (no range avail.) |
| LCR Coho[25] | N/A | N/A | 98.0% (no range avail.) |

[19]Free-flowing river survival rates are estimated for migration under pre-project conditions based on survival rates in un-impounded river reaches per methods outlined Ferguson (2004) and Smith (2004)

[20] The estimated juvenile survival in-river rates shown in this table for transported ESUs are only for those fish that remain in-river for their entire juvenile migration and are not transported.

[21] Estimated adult survival rates for LCR chinook salmon are based on per-project survival rate of SR fall chinook.

[22] Estimated adult survival rates for LCR (spring) chinook salmon are based on Bjornn *et al*. 2000.

[23] Estimated adult survival rates for MCR steelhead are based on per-project survival rate of SR steelhead.

[24] Estimated adult survival rates for LCR steelhead are based on Keefer *et al.* 2002.

[25] Estimated adult survival rates for LCR coho salmon are based on per-project survival rate of SR fall chinook salmon.

**Table 6-7.** Effects of the USBR's proposed action on juvenile passage survival through the FCRPS in its near-term project operations and system configuration. The relative (proportional) survival difference is expressed as (Proposed - Reference) ÷ Reference. Source: NMFS staff.

| ESU | Relative Juvenile In-river Survival Difference | Relative Juvenile System Survival Difference (including latent effects) | Adult Survival Difference | Total Relative Survival Difference (juvenile system survival and adult survival) | Habitat Effects | Qualitative Effect Category |
|---|---|---|---|---|---|---|
| **SR Spring/ Summer Chinook Salmon** | -1.2%<br>(-6.5 to +0.3%)<br><br>Absolute Difference:<br>-0.6%<br>(-3.4 to +0.1%) | -0.1%<br>(-0.5 to +0.5%)<br><br>Absolute Difference:<br>0%<br>(-0.3 to +0.3%) | None | -0.1%<br><br>Absolute Difference:<br>0% | Small to negligible differences in mainstem and below-BON estuary and plume habitat are expected, because the proposed action spring flows are similar to the reference operation flows. The difference in safe passage through barriers is low, based on the juvenile in-river survival estimate, most likely as a result of less flow and spill. Little or no difference in water quality is expected. | Small reduction |

**Table 6-7. (continued).** Effects of the USBR's proposed action on juvenile passage survival through the FCRPS in its near-term project operations and system configuration.

| ESU | Relative Juvenile In-river Survival Difference | Relative Juvenile System Survival Difference (including latent effects) | Adult Survival Difference | Total Relative Survival Difference (juvenile system survival and adult survival) | Habitat Effects | Qualitative Effect Category |
|---|---|---|---|---|---|---|
| **SR Fall Chinook Salmon** | +7.9%* (+0.3 to +98.1%) to +8.7%** (+0.7 to +100.8%)<br><br>Absolute Difference: +1.0%* (+0.1 to +3.0%) to +1.1%** (+0.1 to +3.1%) | Under range of D-values:***<br><br>+3.5 to +3.8% relative system survival difference<br><br>+3 to +6 difference in juveniles below Bonneville per 1000 juveniles arriving at LGR reservoir***<br><br>+6,100 to +12,500 difference in juveniles per two million arriving at LGR reservoir*** | None | Under range of D-values:***<br><br>+3.5 to +3.8% relative system survival difference<br><br>+3 to +6 difference in juveniles below BON Dam per 1000 juveniles arriving at LGR reservoir***<br><br>+6,100 to +12,500 difference in juveniles below BON Dam per two million arriving at LGR reservoir*** | Net survival benefit in mainstem and below-BON habitat, because the summer flows in the PA are considerably higher than the reference operation flows. Differences in spill help improve safe passage through barriers. Possible change in water quality (slightly increased temperature) due to much higher flows in the proposed action. | Small improvement |

* In-river survival sensitivity analysis in which pool survival between MCN and BON is assumed equal in both the reference and proposed operations. This sensitivity analysis was conducted in response to comments because of a lack of empirical reach survival data for SR fall chinook in the lower Columbia River. This difference applies only to the unknown, but small, proportion of the population that migrates entirely in-river.

** In-river survival analysis using SR fall chinook empirical reach survival data from the Snake River, extrapolated to the lower Columbia River using methods described in Appendix D in NMFS (2004a). This difference applies only to the unknown, but small, proportion of the population that migrates entirely in-river.

*** The SR fall chinook in-river survival gap applies only to the unknown, but small, proportion of the population that migrates entirely in the river. Information regarding the proportion of transported fish and their survival rate is needed to properly weight the in-river results. Transport survival is unknown, because the post-Bonneville differential survival (D) is highly uncertain. However, a reasonable range of potential D-values (0.18 - 0.41) was calculated (see Appendix D, Attachment 5 in NMFS 2004a) for use in comparing relative differences between alternative operations.

**Table 6-7. (continued).** Effects of the USBR's proposed action on juvenile passage survival through the FCRPS in its near-term project operations and system configuration.

| ESU | Relative Juvenile In-river Survival Difference | Relative Juvenile System Survival Difference (including latent effects) | Adult Survival Difference | Total Relative Survival Difference (juvenile system survival and adult survival) | Habitat Effects | Qualitative Effect Category |
|---|---|---|---|---|---|---|
| **UCR Spring Chinook Salmon** | -0.2%<br>(-0.9 to +1.3%)<br><br>Absolute Difference:<br>-0.1%<br>(-0.7 to +0.9%) | N/A | None | -0.2%<br><br>Absolute Difference:<br>-0.1% | Same as SR spring/summer chinook. | Small reduction |
| **UWR Chinook Salmon** | N/A | N/A | N/A | | Predominantly yearlings, but also some subyearling migrants. For yearlings, same or less mainstem habitat effects (negligible) as for SR spring/summer chinook. For subyearlings, same as or possibly greater improvements as for SR fall chinook subyearlings. Improved estuarine rearing habitat in summer for populations with small subyearling smolts. | Small reduction |

**Table 6-7. (continued).** Effects of the USBR's proposed action on juvenile passage survival through the FCRPS in its near-term project operations and system configuration.

| ESU | Relative Juvenile In-river Survival Difference | Relative Juvenile System Survival Difference (including latent effects) | Adult Survival Difference | Total Relative Survival Difference (juvenile system survival and adult survival) | Habitat Effects | Qualitative Effect Category |
|---|---|---|---|---|---|---|
| **LCR Chinook Salmon** | Yearling populations above BON: -0.1% (-0.2 to 0%)<br><br>Absolute Difference: -0.1% (-0.2 to 0%)<br><br>Subyearling populations above BON: +0.2% (0% to +0.3%)<br><br>Absolute Difference: +0.1% (0% to +0.3%)<br><br>Populations that spawn below BON: n/a | N/A | None | Yearling populations above BON: -0.1%<br><br>Absolute Difference: -0.1%<br><br>Subyearling populations above BON: +0.2%<br><br>Absolute Difference: +0.1%<br><br>Populations that spawn below BON: n/a | Same or less as SR spring/summer chinook (negligible) for yearlings from populations that spawn above Bonneville (1 of 3 extant spring-run populations in 1 of 6 MPGs).<br><br>Same (or possibly greater) mainstem habitat improvements as SR fall chinook for subyearlings from fall-run populations that spawn above BON (2 of 20 fall-run populations in 1 of 6 MPGs).<br><br>More estuarine rearing habitat for summer subyearling migrants from all fall-run populations. | Negligible for 1 (Hood) spring-run pop. in 1 MPG (Gorge spring-run) above BON. Based on habitat, Low for fall-run populations in 3 fall-run MPGs below BON.<br><br>Small improvement for Upper Gorge, Hood, and Big White Salmon fall-run populations in 1 (Gorge fall-run) MPG above BON.<br><br>Negligible improvement for 2 populations in 1 MPG (Cascade Spring-run) below BON. |

**Table 6-7. (continued).** Effects of the USBR's proposed action on juvenile passage survival through the FCRPS in its near-term project operations and system configuration.

| ESU | Relative Juvenile In-river Survival Difference | Relative Juvenile System Survival Difference (including latent effects) | Adult Survival Difference | Total Relative Survival Difference (juvenile system survival and adult survival) | Habitat Effects | Qualitative Effect Category |
|---|---|---|---|---|---|---|
| **SR Steelhead** | -3.3%<br>(-10.7 to -0.4%)<br><br>Absolute Difference:<br>-1.2%<br>(-4.1 to -0.2%) | -0.3%<br>(-2.8 to +11.0%)<br><br>Absolute Difference:<br>-0.2%<br>(-1.5 to +5.3% | None | -0.3%<br><br>Absolute Difference:<br>-0.2% | Same as SR spring/summer chinook. | Small reduction<br>(Same rationale as SR sp/sum chinook) |
| **UCR Steelhead** | -1.1%<br>(-2.6 to -0.4%)<br><br>Absolute Difference:<br>-0.5%<br>(-1.1 to -0.2%) | N/A | None | -1.1%<br><br>Absolute Difference:<br>-0.5% | Same as SR spring/summer chinook. | Small reduction |

**Table 6-7. (continued).** Effects of the USBR's proposed action on juvenile passage survival through the FCRPS in its near-term project operations and system configuration.

| ESU | Relative Juvenile In-river Survival Difference | Relative Juvenile System Survival Difference (including latent effects) | Adult Survival Difference | Total Relative Survival Difference (juvenile system survival and adult survival) | Habitat Effects | Qualitative Effect Category |
|---|---|---|---|---|---|---|
| **MCR Steelhead** | Populations migrating through<br>**4 dams:**<br>-1.1%<br>(-2.6 to -0.4%)<br>Absolute Diff.:<br>-0.5%<br>(-1.1 to -0.2%)<br>**3 dams & pools:**<br>-0.8%<br>(-2.3 to -0.1%)<br>Absolute Diff.:<br>-0.5%<br>(-0.9 to -0.1%)<br>**3 dams:**<br>-0.4%<br>(-1.5 to +0.2%)<br>Absolute Diff.:<br>-0.3%<br>(-0.7 to +0.2)<br>**2 dams:**<br>-0.4%<br>(-1.5 to +0.1%)<br>Absolute Diff.: -0.3%<br>(-0.7 to +0.1)<br>**1 dam**:<br>-0.2%<br>(-0.8 to +0.1%<br>Absolute Diff.: -0.2%<br>(-0.5 to +0.1%) | N/A | None | **4 dams**:<br>-1.1% for 5 populations in 2 MPGs<br>Absolute Diff.:<br>-0.5%<br>**3 dams & pools**:<br>-0.8% for 1 population in 1 MPG<br>Absolute Diff.:<br>-0.5%<br>**3 dams**:<br>-0.4% for 7 populations in 3 MPGs<br>Absolute Diff.:<br>-0.3%<br>**2 dams**:<br>-0.4% for 2 populations in 1 MPG<br>Absolute Diff.:<br>-0.3%<br>**1 dam**:<br>-0.2%<br>Absolute Diff.:<br>-0.2% | Same or less as SR spring/summer chinook. | Small reduction for 3 populations in 2 MPGs that spawn upstream of McNary Dam.<br><br>Small to negligible reduction for 7 populations in 3 MPGs that spawn between McNary and John Day dams.<br><br>Small to negligible reduction for 2 populations in 1 MPG that spawns downstream of John Day Dam. |

**Table 6-7. (continued).** Effects of the USBR's proposed action on juvenile passage survival through the FCRPS in its near-term project operations and system configuration.

| ESU | Relative Juvenile In-river Survival Difference | Relative Juvenile System Survival Difference (including latent effects) | Adult Survival Difference | Total Relative Survival Difference (juvenile system survival and adult survival) | Habitat Effects | Qualitative Effect Category |
|---|---|---|---|---|---|---|
| **UWR Steelhead** | N/A | N/A | None | N/A | Estuary and plume habitat effects small to negligible, because little difference in flows. | Small to negligible reduction |
| **LCR Steelhead** | Populations migrating through 1 dam:<br>-0.2%<br>(-0.8 to +0.1%)<br><br>Absolute Difference:<br>-0.2%<br>(-0.5 to +0.1%) | N/A | None | -0.2% for 3 of 20 populations in 2 of 4 MPGs<br>Absolute Difference:<br>-0.2%<br><br>No difference for the other 17 populations | Same as SR spring/summer chinook | Negligible reduction for 4 populations in 2 MPGs that migrate through Bonneville pool and dam<br><br>No effect for 16 populations that spawn below BON |
| **CR Chum Salmon** | N/A, if chum spawn above Bonneville Dam, but some juveniles migrate through 1 Dam: possibly ~ +0.2% survival improvement | N/A | None | ~ +0.2% if there is an extant population above Bonneville Dam<br><br>No difference for 7 populations in 3 MPGs | Could reduce spawning and rearing habitat, because fall/winter flows are lower in PA than in reference operation, although generally above 125 kcfs target. Juvenile migration and rearing habitat effects similar to SR fall chinook, but possibly more significant because of smaller size and greater reliance on estuarine rearing. | Small to negligible improvement<br>(for all populations, because juvenile rearing habitat increased by higher summer flows and little change in temperatures, although spawning and incubation habitat could be reduced by some lower fall/winter flows) |

**Table 6-7. (continued).** Effects of the USBR's proposed action on juvenile passage survival through the FCRPS in its near-term project operations and system configuration.

| ESU | Relative Juvenile In-river Survival Difference | Relative Juvenile System Survival Difference (including latent effects) | Adult Survival Difference | Total Relative Survival Difference (juvenile system survival and adult survival) | Habitat Effects | Qualitative Effect Category |
|---|---|---|---|---|---|---|
| **SR Sockeye Salmon** | N/A, effects assumed to be slightly greater than the difference for SR spring/summer chinook and SR steelhead | N/A | None | Assumed to be slightly greater than the difference for SR spring/summer chinook and SR steelhead | Assumed similar to SR spring/summer chinook and SR steelhead | Small reduction |
| **LCR Coho Salmon** | N/A, but expected to be similar to yearling-type LCR chinook populations above BON.<br><br>No change for all other pops | N/A | None | If similar to yearling-type LCR chinook, –0.1% for 2 populations in 1 MPG<br><br>No difference for 19 populations in 3 MPGs | Similar to SR spring/summer chinook (negligible) for populations that spawn above Bonneville | Negligible reduction for Upper Gorge and Hood River populations in the Gorge MPG<br><br>No effect for the remaining 19 populations in 3 MPGs (including 1 below-BON population in the Gorge MPG) |

**Table 6-8.** Estimated average juvenile and adult survival rates over 1994-2003 water years through the FCRPS in its long-term configuration under the USBR's proposed action. These estimates do not include possible post-Bonneville latent mortality of in-river migrants (Appendix A). Source: NMFS staff

| ESU | Estimated Juvenile In-river Survival Rate | Estimated Juvenile System Survival Rate (including latent effects) | Estimated Adult Survival Rate[1] |
|---|---|---|---|
| SR Spring/Summer Chinook Salmon[10] | 57.8% (48.7% to 64.7%) | 53.3% (49.6% to 57.6%) | 84.6% (75.0% to 93.6% |
| SR Fall Chinook Salmon[2, 3] | 16.2% (6.9% to 24.7%)<br>6.2 in-river fish per 1000 @ LGR pool alive below BON (2.4-10.8) | N/A | 84.7% (80.0% to 81.3%) |
| UCR Spring Chinook Salmon | 73.1% (57.5% to 80.2%) | N/A | 92.0% (91.1% to 93.5%) |
| LCR Chinook: | | | |
| Gorge Fall MPGs[4] | 86.2% (78.4% to 97.4%) | N/A | 98.0% (no range avail.) |
| Gorge Spring MPGs[5] | 90.8% (84.8% to 94.0%) | N/A | 96.5% (no range avail.) |
| Below BON Dam MPGs | N/A | N/A | N/A |
| UWR Chinook Salmon | N/A | N/A | N/A |
| SR Steelhead[10] | 36.6% (8.0% to 50.3%) | 50.5% (42.0% to 53.6%) | 83.3% (75.0% to 89.9%) |
| UCR Steelhead | 54.7% (23.9% to 69.4%) | N/A | 94.1% (92.2% to 96.1%) |
| MCR Steelhead:[6] | | | |
| Passing MCN-BON | 54.7% (23.9% to 69.4%) | N/A | 91.1% (no range avail.) |
| Passing JDA Pool -BON | 61.9% (31.4% to 77.7%) | N/A | 93.3% (no range avail.) |
| From JDA Dam-BON | 76.1% (45.1% to 93.0%) | N/A | 93.3% (no range avail.) |
| Passing TDA-BON | 78.2% (46.3% to 95.5%) | N/A | 95.4% (no range avail.) |
| Passing BON Dam | 87.0% (64.4% to 97.6%) | N/A | 97.7% (no range avail.) |
| LCR Steelhead:[7] | | | |
| Passing BON Dam | 87.0% (64.4% to 97.6%) | N/A | 97.7% (no range avail.) |
| Below BON Dam | N/A | N/A | N/A |
| UWR Steelhead | N/A | N/A | N/A |
| CR Chum | N/A | N/A | N/A |
| SR Sockeye | N/A | N/A | 83.1 (no range available) |
| LCR Coho[8] | N/A | N/A | 98.0 (no range available) |

[1] Free-flowing river survival rates are estimated for migration under pre-project conditions based on survival rates in un-impounded river reaches per methods outlined Ferguson (2004) and Smith (2004)
[2] The estimated juvenile in-river survival rates shown in this table for transported ESUs are only for those fish that remain in-river for their entire juvenile migration and are not transported.
[3] The estimated juvenile survival rates shown in this table for transported ESUs are only for those fish that remain in-river for their entire juvenile migration and are not transported.
[4] Estimated adult survival rates for LCR (fall) chinook salmon are based on Bjornn *et al.* 2000.
[5] Estimated adult survival rates for LCR (spring) chinook salmon are based on per-project survival rate of SR spring/summer chinook salmon.
[6] Estimated adult survival rates for MCR steelhead are based on per-project survival rate of SR steelhead.
[7] Estimated adult survival rates for LCR steelhead are based on per-project survival rate of SR steelhead.
[8] Estimated adult survival rates for LCR coho salmon are based on per-project survival rate of SR fall chinook salmon.

**Table 6-9.** Effects of the USBR's proposed action on juvenile passage survival through the FCRPS in its long-term project operations and system configuration. The relative (proportional) survival difference is expressed as (Proposed - Reference) ÷ Reference. Source: NMFS staff.

| ESU | Relative Juvenile In-river Survival Difference | Relative Juvenile System Survival Difference (including latent effects) | Relative Adult Survival Difference | Total Relative Survival Difference (juvenile system survival and adult survival) | Habitat Effects | Qualitative Effect Category |
|---|---|---|---|---|---|---|
| **SR Spring/ Summer Chinook Salmon** | -1.1%<br>(-5.9% to -0.3%)<br><br>Absolute Difference:<br>-0.7%<br>(-3.4% to -0.1%) | -0.3%<br>(-2.6 to +0.6%)<br><br>Absolute Difference:<br>-0.2%<br>(-1.4 to +0.3%) | None | -0.3%<br><br>Absolute Difference:<br>-0.2% | Small to negligible differences in mainstem and below-BON estuary and plume habitat is expected, because the long-term PA spring flows are similar to the reference operation flows. Safe passage through barriers is similar to near-term survival (low effect). Little or no change in water quality is expected. | Small reduction |

**Table 6-9. (continued)** Effects of the USBR's proposed action on juvenile passage survival through the FCRPS in its long-term project operations and system configuration.

| ESU | Relative Juvenile In-river Survival Difference | Relative Juvenile System Survival Difference (including latent effects) | Relative Adult Survival Difference | Total Relative Survival Difference (juvenile system survival and adult survival) | Habitat Effects | Qualitative Effect Category |
|---|---|---|---|---|---|---|
| **SR Fall Chinook Salmon** | +7.8%* (+0.2 to +98.1%) to +8.6%** (+0.9 to +100.9%)<br><br>Absolute Difference: +1.2% (0% to +3.4%) to +1.3% (+0.2 to +3.5%) | Under a range of D-values:*** +3.5 to +3.9% relative system survival difference +3 to +6 difference in juveniles below Bonneville per 1000 juveniles arriving at LGR reservoir*** +6400 to +12,800 difference in juveniles per two million arriving at LGR reservoir*** | None | Under range of D-values:*** +3.5 to +3.9% relative system survival difference +3 to 6 difference in juveniles below Bonneville per 1000 juveniles arriving at LGR reservoir*** +6400-12,800 difference in juveniles per two million arriving at LGR reservoir*** | Net survival benefit in mainstem and below-BON habitat, because the summer flows in the PA are considerably higher than the reference operation flows. Differences in spill help improve safe passage through barriers. Possible change in water quality (slightly increased temperature) due to much higher flows in the PA. | Small improvement |

* In-river survival sensitivity analysis in which pool survival between MCN and BON is assumed equal in both the reference and proposed operations. This sensitivity analysis was conducted in response to comments because of a lack of empirical reach survival data for SR fall chinook in the lower Columbia River. This difference applies only to the unknown, but small, proportion of the population that migrates entirely in-river.

** In-river survival analysis using SR fall chinook empirical reach survival data from the Snake River, extrapolated to the lower Columbia River using methods described in Appendix D in NMFS (2004a). This difference applies only to the unknown, but small, proportion of the population that migrates entirely in-river.

*** The SR fall chinook in-river survival gap applies only to the unknown, but small, proportion of the population that migrates entirely in-river. Information on the proportion of transported fish and their survival rate is needed to properly weight the in-river results. Transport survival is unknown because the post-Bonneville differential survival (D) is highly uncertain (see Section 5.2.2.3.1.1). However, a reasonable range of potential D-values (0.18 - 0.41) was calculated (Appendix D, Attachment 5 in NMFS 2004a) for use in comparing relative differences between alternative operations.

**Table 6-9. (continued)** Effects of the USBR's proposed action on juvenile passage survival through the FCRPS in its long-term project operations and system configuration.

| ESU | Relative Juvenile In-river Survival Difference | Relative Juvenile System Survival Difference (including latent effects) | Relative Adult Survival Difference | Total Relative Survival Difference (juvenile system survival and adult survival) | Habitat Effects | Qualitative Effect Category |
|---|---|---|---|---|---|---|
| **UCR Spring Chinook Salmon** | -0.5% (-0.9 to -0.2%)<br><br>Absolute Difference: -0.3% (-0.5 to -0.2%) | N/A | None | -0.5%<br><br>Absolute Difference: -0.3% | Same as SR spring/summer chinook. | Small reduction |
| **UWR Chinook Salmon** | N/A | N/A | N/A | N/A | Predominantly yearlings, but also some subyearling migrants. Same or less as SR spring/summer chinook (minor) for yearlings. Same as or possibly greater improvements in mainstem habitat than for SR fall chinook subyearlings. Improved estuarine rearing habitat in summer for all populations with small subyearling smolts. | Small reduction to small improvement |

**Table 6-9. (continued)** Effects of the USBR's proposed action on juvenile passage survival through the FCRPS in its long-term project operations and system configuration.

| ESU | Relative Juvenile In-river Survival Difference | Relative Juvenile System Survival Difference (including latent effects) | Relative Adult Survival Difference | Total Relative Survival Difference (juvenile system survival and adult survival) | Habitat Effects | Qualitative Effect Category |
|---|---|---|---|---|---|---|
| **LCR Chinook Salmon** | Yearling populations above BON: -0.2% (-0.2 to -0.1%)<br><br>Absolute Difference: -0.2% (-0.2 to -0.1%) | N/A | None | Yearling populations above BON: -0.2%<br><br>Absolute Difference: -0.2% | Same or less as SR spring/summer chinook (minor) for yearlings from populations that spawn above Bonneville, with some survival improvements at Bonneville Dam. | Negligible for 1 (Hood) spring-run pop in 1 MPG (Gorge spring-run) above BON. Based on habitat, Low for fall-run populations in 3 fall-run MPGs below BON. |
| | Subyearling populations above BON: +0.2% (0 to +0.3%)<br><br>Absolute Difference: +0.1% (0 to +0.3%) | | | Subyearling populations above BON: +0.2%<br><br>Absolute Difference: +0.1% | Same (or possibly greater) mainstem habitat improvements as for SR fall chinook subyearlings from fall-run populations that spawn above BON (2 of 20 fall-run populations in 1 of 6 MPGs). | Small improvement for Upper Gorge, Hood, and Big White Salmon fall-run populations in 1 Gorge fall-run MPG above BON. |
| | Populations that spawn below BON: no change. | | | Populations that spawn below BON: n/a | More estuarine rearing habitat in summer subyearling migrants from all fall-run populations. | Negligible improvement for 2 populations in 1 MPG (Cascade Spring run) below BON. |

**Table 6-9. (continued)** Effects of the USBR's proposed action on juvenile passage survival through the FCRPS in its long-term project operations and system configuration.

| ESU | Relative Juvenile In-river Survival Difference | Relative Juvenile System Survival Difference (including latent effects) | Relative Adult Survival Difference | Total Relative Survival Difference (juvenile system survival and adult survival) | Habitat Effects | Qualitative Effect Category |
|---|---|---|---|---|---|---|
| **SR Steelhead** | -3.4%<br>(-11.2 to -0.6%)<br><br>Absolute Difference:<br>-1.3%<br>(-4.6 to -0.3%) | 0%<br>(-2.4 to +10.5%)<br><br>Absolute Difference:<br>0%<br>(-1.5 to +5.1%) | None | 0%<br><br>Absolute Difference:<br>0% | Same as SR spring/summer chinook. | Small reduction (Same rationale as SR sp/sum chinook) |
| **UCR Steelhead** | -1.2%<br>(-3.0 to -0.3%)<br><br>Absolute Difference:<br>-0.7%<br>(-1.2 to -0.2%) | N/A | None | -1.2%<br><br>Absolute Difference:<br>-0.7% | Same as SR spring/summer chinook. | Small reduction |

**Table 6-9. (continued)** Effects of the USBR's proposed action on juvenile passage survival through the FCRPS in its long-term project operations and system configuration.

| ESU | Relative Juvenile In-river Survival Difference | Relative Juvenile System Survival Difference (including latent effects) | Relative Adult Survival Difference | Total Relative Survival Difference (juvenile system survival and adult survival) | Habitat Effects | Qualitative Effect Category |
|---|---|---|---|---|---|---|
| **MCR Steelhead** | Populations migrating through **4 dams:** -1.2% (-3.0 to -0.3%) Absolute Diff : -0.7% (-1.2 to -0.2%) **3 dams & pools:** -0.9% (-2.3 to -0.3%) Absolute Diff.: -0.6% (-1.0 to -0.2%) **3 dams:** -0.5% (-1.5 to 0%) Absolute Diff.: -0.4% (-0.8 to 0%) **2 dams:** -0.5% (-1.5 to 0%) Absolute Diff.: -0.4% (-0.8 to 0%) **1 dam:** -0.3% (-0.8 to 0%) Absolute Diff.: -0.2% (-0.5 to 0%) | N/A | None | Populations migrating through **4 dams:** -1.2% for 5 populations in 2 MPGs Absolute Diff: -0.7% **3 dams & pools**: -0.9% for 7 populations in 3 MPGs Absolute Diff.: -0.6% **3 dams:** -0.5% for 1 population in 1 MPG Absolute Diff.: -0.4% **2 dams:** -0.5% for 2 populations in 1 MPG Absolute Diff.: -0.4% **1 dam:** -0.3% Absolute Difference: -0.2% | Same as SR spring/summer chinook. | Small reduction for 5 populations in 2 MPGs that spawn upstream of McNary Dam. Small to negligible reduction for 7 populations in 3 MPGs that spawn between McNary and John Day dams. Small to negligible reduction for 2 populations in 1 MPG that spawns downstream of John Day Dam. |

**Table 6-9. (continued)** Effects of the USBR's proposed action on juvenile passage survival through the FCRPS in its long-term project operations and system configuration.

| ESU | Relative Juvenile In-river Survival Difference | Relative Juvenile System Survival Difference (including latent effects) | Relative Adult Survival Difference | Total Relative Survival Difference (juvenile system survival and adult survival) | Habitat Effects | Qualitative Effect Category |
|---|---|---|---|---|---|---|
| **UWR Steelhead** | N/A | N/A | None | N/A | Estuary and plume habitat effects small to negligible, because little change in flows. | Small to negligible reduction |
| **LCR Steelhead** | Populations migrating through 1 dam:<br>-0.3%<br>(-0.8 to 0%)<br><br>Absolute Difference:<br>-0.2%<br>(-0.5 to 0%) | N/A | None | -0.3% for 3 of 20 populations in 2 of 4 MPGs<br>Absolute Difference:<br>-0.2%<br><br>No difference for the other 17 populations | Same as SR spring/summer chinook | Negligible reduction for 4 populations in 2 MPGs that migrate through Bonneville pool and dam<br><br>No effect for 16 populations that spawn below BON |
| **CR Chum Salmon** | N/A, if chum spawn above Bonneville Dam, but some juveniles migrate through 1 Dam: possibly ~ +0.2% survival | N/A | None | ~ +0.2% if there is an extant population above Bonneville Dam<br><br>No change for 7 populations in 3 MPGs | Could reduce spawning and rearing habitat, because fall/winter flows in PA are lower than in reference operation, although generally above 125 kcfs target. Juvenile migration and rearing habitat effects similar to SR fall chinook, but possibly more significant because of smaller size and greater reliance on estuarine rearing. | Small to negligible improvement<br>(for all populations, because juvenile rearing habitat increased by higher summer flows and little change in temperatures, although spawning and incubation habitat could be reduced by lower fall/winter flows) |

**Table 6-9. (continued)** Effects of the USBR's proposed action on juvenile passage survival through the FCRPS in its long-term project operations and system configuration.

| ESU | Relative Juvenile In-river Survival Difference | Relative Juvenile System Survival Difference (including latent effects) | Relative Adult Survival Difference | Total Relative Survival Difference (juvenile system survival and adult survival) | Habitat Effects | Qualitative Effect Category |
|---|---|---|---|---|---|---|
| **SR Sockeye Salmon** | N/A, effects assumed to be slightly greater than the difference for SR spring/summer chinook and SR steelhead | N/A | None | Assumed to be slightly greater than the difference for SR spring/ summer chinook and SR steelhead | Assumed similar to SR spring/ summer chinook and SR steelhead | Small reduction (same rationale as SR sp/sum chinook) |
| **LCR Coho Salmon** | N/A, effects expected to be similar to yearling-type LCR chinook populations above BON.<br><br>No change for all other pops. | N/A | None | If similar to yearling-type LCR chinook ~ -0.2% for 2 populations in 1 MPG Absolute Difference: ~ -0.2%<br><br>No change for 19 populations in 3 MPGs | Similar to SR spring/summer chinook (negligible) for populations that spawn above Bonneville | Negligible reduction for Upper Gorge and Hood River populations in the Gorge MPG<br><br>No effect for remaining 19 populations in 3 MPGs (including 1 below-BON population in the Gorge MPG) |

### 6.3.1 Snake River Spring/Summer Chinook Salmon

#### 6.3.1.1 Habitat Function

As described in Section 6.2, compared to the reference operation, the USBR's PA would reduce spring flows in the action area. Spring flow reductions would affect habitat function with respect to water velocity, safe passage, and water quality (e.g., water temperature and TDG) during the spring period when juvenile and adult SR spring/summer chinook salmon migrate through the FCRPS projects in the action area. The spring flow reductions that would occur under USBR's PA would also affect flow-related habitat features (e.g., estuarine shallow water habitat area, the size of the Columbia River plume).

By reducing the frequency and severity of TDG-producing involuntary spill events, the PA would beneficially affect juvenile SR spring/summer chinook salmon migration habitat in above average runoff years. For example, the PA would reduce the frequency that May flows would cause spills in excess of the Corps' gas caps by 8%, compared to the reference operation (Table 6-5). Conversely, by slightly reducing voluntary spill levels (at or below the gas caps) at the three FCRPS projects where the criteria for spill are based on total project discharge (at Lower Monumental, John Day and The Dalles Dams), the PA would slightly adversely affect spring juvenile migration habitat in below average water years. However, the effect of reducing involuntary spill events in above average water years would create benefits that would occur throughout the migratory corridor and would benefit both in-river and transported migrants, while reductions in voluntary spill would be very small, would affect only in-river migrants, and would occur only at one or more of the FCRPS dams where spill rates are based on total project discharge. For these reasons, NMFS considers the PA to provide a net benefit to juvenile migration habitat for all spring migrants.

By reducing spring flows in the lower Columbia River by about 3%, the PA would slightly reduce juvenile migration and rearing habitat in the Columbia River estuary and plume during the spring and early summer, when SR spring/summer chinook salmon use these habitats. There would likely be only a minor difference in the amount of shallow-water habitat available to SR spring/summer chinook salmon juveniles, based on the small difference in flow between the USBR's proposed action operation and the reference operation.[36] Again, these effects would vary by water year type. During low water years, Columbia River estuary and plume habitat conditions (area, turbidity, and water velocity) would be reduced by roughly the fraction of flow reduction caused by the PA. During high water years, the effects on estuary and plume habitat would be attenuated by the prevailing higher flows.

The PA would have negligible or small beneficial effects on spring water temperatures and water temperature-related juvenile fish survival (Tables 6-2 and 6-3).

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[36]Yearling chinook salmon have a very low reliance on shallow-water rearing habitat in the Columbia River estuary (Fresh et al. 2004)

### 6.3.1.2 Mainstem Dam and Reservoir Passage Survival – SIMPAS Results

**6.3.1.2.1. Near-term**. SIMPAS modeling results indicate that the USBR's PA would reduce the system survival of juvenile SR spring/summer chinook salmon through the action area by a negligible amount (average -0.1%, range -0.5% to 0.5%). The system survival estimate includes both the direct survival and differential post-Bonneville survival (D) of transported fish. Survival for fish that remain in-river through the Lower Granite to Bonneville reach would be reduced by a low amount (average -1%, range -7% to +0.3%) (Table 6-7). The effects on system survival are much smaller than effects on in-river migrants because a large proportion of juvenile migrants are collected and transported past FCRPS dams, thereby avoiding mortality associated with dam and reservoir passage.

No reduction in adult dam passage survival is expected as a result of the PA.

**6.3.1.2.2. Long-term.** With all the expected long-term system configuration improvements to the FCRPS in place, the PA would have a negligible effect on SR spring/summer chinook salmon system survival (average -0.3%, range -3 to +1%) (Table 6-9). The estimated reduction in in-river survival for this ESU would be low (average -1%, range -6% to 0%).

No reduction in adult dam passage survival is expected as a result of the PA.

### 6.3.1.3 Net Effect on Essential Features of Critical Habitat

The PA would negatively affect two essential features of designated critical habitat used by SR spring/summer chinook salmon under the Environmental Baseline Approach (water velocity and safe passage) and beneficially affect a third (water quality). As described in Section 6.2.1, on average, spring flows under the PA would be about 8 kcfs lower than the spring flows in the reference operation. The lowered flows negligibly reduce water velocity and safe passage through the FCRPS, which are essential features of SR spring/summer chinook salmon critical habitat. By reducing the frequency that gas caps would be exceeded due to involuntary spills at FCRPS projects in the migratory corridor during the spring in above average water years by about 8%, the PA would reduce elevated TDG conditions in those years, thereby beneficially affecting water quality for both juvenile and adult spring migrants. No difference in the essential feature of water quality, relative to the temperature requirements of SR spring/summer chinook salmon, is expected during the spring. Safe passage can be assessed by the change in survival of migrating fish that results from the PA, compared to the reference operation. Because average water velocities in the impounded river reach vary proportionately with discharge, spring water velocity is expected to be about 8% lower in the Snake River and 3% lower in the Columbia River under the PA, compared to the reference operation. The lower flow and lower velocity are expected to have no effect, or possibly a very small beneficial effect, on adult passage success and survival. As described in Section 6.3.1.2, the lower flow and lower velocity are expected to reduce the survival of juvenile yearling migrants that are not transported by about 1%. Considering the entire population, including the majority of fish that are transported, the lower flow would have a negligible effect on the average survival rate of juvenile SR spring/summer chinook salmon.

Under the Listing Conditions Approach, the PA is not likely to negatively impact essential features of critical habitat from conditions existing at the time of listing (1992). The projected flows during the spring migration under the PA would be generally higher than those resulting from management actions prior to 1992, when deeper winter drafts of FCRPS storage reservoirs and subsequently lower spring flows were common.

Effects on the essential features of critical habitat that would occur over the long-term would be similar to those described above for the short-term period.

### 6.3.2 Snake River Fall Chinook Salmon

#### 6.3.2.1 Habitat Function

As described in Section 6.2, the USBR's PA is expected to provide a small improvement in habitat function with respect to water quantity and water velocity during the summer period when juvenile SR fall chinook salmon migrate through the action area when compared to the environmental baseline (reference operation). This is because the PA would slightly increase average summer flows by about 3 kcfs (Table 6-1).

Water temperature effects are somewhat mixed. At Lower Granite Dam, water temperature decreases in the months of May and June (Tables 6-2 and 6-3) would likely improve the survival of juvenile SR fall chinook salmon rearing in Lower Granite Reservoir. In late June and July, when the majority of subyearling juveniles are actively migrating, any increase in water temperatures would decrease survival through Lower Granite Reservoir.[37] The estimated juvenile survival effects of these temperature changes are presented in Section 6.3.2.3. Water temperatures would be only slightly reduced at Ice Harbor Dam and unaffected by the PA at McNary Dam during the juvenile migration period, which suggests that the in-river water temperature-related habitat conditions for juvenile SR fall chinook salmon under the PA would show a small improvement over reference operation conditions downstream from Lower Granite Dam.

Temperature-related habitat conditions for migrating adults upstream from Lower Granite Dam would also be slightly adversely affected by the PA (Tables 6-2 and 6-3). However, by October, when SR fall chinook salmon begin spawning, the PA would have no effect on flows, and thus no effect on water temperature or water temperature-related spawning habitat.

The USBR's PA is expected to have a small effect on the quantity and quality of juvenile migration and rearing habitat in the Columbia River estuary and plume during the summer, when SR fall chinook salmon are in these areas (Section 6.2.1.1). As a result, there may be small differences in juvenile survival and migration time through the estuary and in the shape and extent of the Columbia River plume. As the ocean-type SR fall chinook salmon smolt and migrate as subyearlings, much of their growth and development occurs above Lower Granite

[37]This is partly due to a modeling artifact. The hydrologic analysis assumes a flow-based operation of Dworshak Dam. In fact, operations of Dworshak Dam are carefully managed in real time to minimize the magnitude and duration of exceedances of 20°C at Lower Granite Dam. Thus, the adverse summer water temperature effects identified in this analysis likely overstate the PA's effects and are therefore conservative.

Dam (Connor et al. 2003). As a result, SR fall chinook salmon more closely resemble yearling chinook salmon by the time they reach the estuary (Fresh et al. 2004).

In addition, Connor et al. (2004) indicate the existence of an alternative life history for SR fall chinook salmon, e.g., a reservoir-type SR fall chinook salmon, which migrate as yearling smolts. Accordingly, yearling chinook salmon may rely on shallow-water rearing habitat in the Columbia and Snake rivers from Lower Granite Reservoir to below Bonneville Dam, as well as shallow water habitat in the lower estuary (Fresh et al. 2004). Using the Environmental Baseline Approach, there is likely to be a small increase in the amount of shallow-water habitat available to SR fall chinook salmon juveniles in the upper estuary between Bonneville Dam and RM 35, and a small but unquantifiable increase below RM 35, because of the change in summer flow. This increase should have a slight positive impact on this ESU.

#### 6.3.2.2 Mainstem Dam and Reservoir Passage Survival – SIMPAS Results

The following SIMPAS results apply only to subyearling migrants. The effects on reservoir-type (yearling) migrants from this ESU are discussed in Section 6.3.2.3. Results for both system survival, including transported fish, and in-river survival are presented below.

**6.3.2.2.1 Near-term**. SIMPAS modeling results indicate that the PA would have a medium beneficial effect on juvenile SR fall chinook salmon system survival through the FCRPS (average 3% to 4% [depending on D], range 0.1 to 30%). Survival for fish that transit the FCRPS in-river would be improved by a medium amount (average 8% to 9%, range 0.7% to 100%) (Table 6-7). The effects on system survival are much smaller, because a large proportion of juvenile migrants are collected and transported past FCRPS dams. The system survival estimate includes direct survival and a range of differential post-Bonneville survival rates (D) of transported fish.

Adult survival is expected to be unchanged by the PA in the near-term.

**6.3.2.2.2 Long-term**. By 2014, with all the expected long-term system configuration improvements to the FCRPS in place, the PA would provide a medium benefit to ocean-type juvenile SR fall chinook salmon system survival (average 3% to 4% [depending on D], range of 0% to 29%) (Table 6-9). In-river survival would be improved to a medium extent (average 8% to 9%, range 0.6% to 100%).

Adult survival would remain unchanged by the PA in the long-term.

#### 6.3.2.3 Effects on Reservoir-type SR Fall Chinook Salmon Juveniles

The above results are based on an assumption of a subyearling ocean-type life history. The effects of the USBR's PA on the yearling life history component of the population are uncertain, but are likely similar to the PA's effects on subyearlings. To the extent that reservoir-type (yearling) fish rear in areas upstream of one or more mainstem FCRPS dams, subsequent reach survival is likely somewhat higher than it is for subyearlings (i.e., because yearling chinook salmon reach survival is generally higher than that of subyearlings). Thus the system survival improvements associated with the PA for subyearlings likely also accrue to the yearling life history. With regard to water temperature effects, juveniles rearing in mainstem FCRPS reservoirs in the Snake River may be subject to adverse water temperature effects.[38] Based on the EPA and Corps water temperature modeling results, slightly higher water temperatures, with increases ranging between 0.2° and 1°C, are expected in FCRPS lower Snake River reservoirs during the months of August and September under the PA as compared to the reference operation (Tables 6-2 and 6-3). However, juveniles rearing in lower Columbia River reservoirs would be unaffected by the PA because water temperature effects do not propagate that far downstream. Moreover, the modeled mainstem Snake River water temperatures are lower than the ambient water temperatures in nearby tributaries during the months of August and September (Schneider 2005).

#### 6.3.2.4 Water Temperature-Flow Effects on Lower Granite Reach Survival

Connor (2003) developed a multiple regression model relating the survival of juvenile SR fall chinook salmon (i.e., from various release locations in the Hells Canyon reach of the Snake River to Lower Granite Dam) to flow and water temperature data collected at Lower Granite Dam. NMFS estimated the effects of the proposed action on subyearling migrant survival through this reach for three water-year conditions (average, wet, and dry) using this model, flow data developed by NMFS' staff (Appendix A), and water temperature data derived from EPA and Corps models (Tables 6-10 and 6-11).[39] Details of this analysis are provided in Appendix A.

Unfortunately, the simulated flow and temperature conditions frequently exceed the range of conditions observed during model development and thus some of the results are extrapolations with unknown statistical validity. The most consistently valid results are for the month of July. June simulated conditions are consistently beyond the range of observed conditions and August and September simulated conditions are generally beyond the range of observations.

The peak of SR fall chinook salmon juvenile outmigration in the Hells Canyon reach is during late June and July. As stated above, the June results are of questionable validity. Estimated survival for subyearling migrants during July would be higher under the proposed action than the reference operation for all three types of water years when using temperatures derived from both the EPA and Corps water temperature models (Tables 6-10 and 6-11). The exception is a negligible (-0.3%) reduction in subyearling survival during the wet water year when the temperatures were derived from the Corps' model. Results for June, August, and September are derived by extrapolating outside the range of the empirical observations and are therefore unreliable. Therefore, these results show only that the proposed action would provide a low to medium survival benefit to SR fall chinook juveniles upstream from Lower Granite Dam during July.

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[38]The physical location(s) of reservoir-type juvenile SR fall chinook salmon rearing is unknown.

[39]Because the model was based on empirical data for the subyearling life stage of SR fall chinook salmon, it may not be a good predictor of relationships between flow, temperature, and survival for the recently-described yearling life history type (Connor 2004).

**Table 6-10.** Juvenile SR fall chinook flow and water temperature (EPA model derived) related survival in Lower Granite reservoir under the reference operation (RO) and the proposed action (PA) for average, wet, and dry water years Source: NMFS staff.

| Month/Scenario | Flow | Temperature | Survival | Relative Survival Change |
|---|---|---|---|---|
| **AVERAGE WATER YEAR (1995)** | | | | |
| June/RO | 115770* | 14.5* | 100.0% | |
| June/PA | 105540* | 14.3* | 100.0% | 0.0% |
| July/RO | 58490 | 18.7 | 51.1% | |
| July/PA | 63020 | 18.7 | 54.4% | 6.5% |
| Aug/RO | 26840 | 19.2 | 23.6% | |
| Aug/PA | 33070* | 19.5 | 26.3% | 11.3% |
| Sep/RO | 25620* | 19.6 | 19.9% | |
| Sep/PA | 29530* | 19.9* | 21.1% | 6.1% |
| **WET WATER YEAR (1997)** | | | | |
| June/RO | 169160* | 14.1* | 100.0% | |
| June/PA | 142200* | 13.7* | 100.0% | 0.0% |
| July/RO | 58950 | 19.5 | 46.1% | |
| July/PA | 58720 | 19.4 | 46.2% | 0.3% |
| Aug/RO | 32440 | 19.6 | 25.3% | |
| Aug/PA | 38180 | 19.7 | 28.4% | 12.2% |
| Sept/RO | 32090 | 18.4 | 33.6% | |
| Sept/PA | 35820 | 18.6 | 34.7% | 3.0% |
| **DRY WATER YEAR (2000)** | | | | |
| June/RO | 65950 | 15.5* | 79.7% | |
| June/PA | 63230 | 15.4* | 78.2% | -1.8% |
| July/RO | 32160 | 18.7 | 31.2% | |
| July/PA | 36430 | 19.0 | 32.3% | 3.4% |
| Aug/RO | 19440* | 20.2* | 11.0% | |
| Aug/PA | 23670* | 20.4* | 12.6% | 14.5% |
| Sep/RO | 22900* | 19.0 | 22.5% | |
| Sep/ PA | 25880* | 19.1 | 23.6% | 4.9% |

* Either water temperature or flow values are outside of the range of values used in developing the regression model. The estimated survivals are therefore extrapolations beyond the range of the empirical data. Such results are accurate only if the regression function which fits the past observations of the independent variable (i.e., water temperature or flow) is appropriate over a wider range of the variable. NMFS recognizes this limitation and places low confidence in these extrapolated results.

**Table 6-11.** Juvenile SR fall chinook flow and water temperature (Corps model derived) related survival in Lower Granite reservoir under the reference operation (RO) and the proposed action (PA) for average, wet, and dry water years (Source, Appendix A).

| Month/Scenario | Flow | Temperature | Survival | Relative Survival Change |
|---|---|---|---|---|
| **AVERAGE WATER YEAR (1995)** | | | | |
| June/RO | 115770* | 13.6* | 100.0% | |
| June/PA | 105540* | 13.6* | 100.0% | 0.0% |
| July/RO | 58490 | 16.4 | 67.5% | |
| July/PA | 63020 | 16.5 | 70.2% | 4.0% |
| Aug/RO | 26840 | 17.1 | 38.8% | |
| Aug/PA | 33070* | 17.8 | 38.5% | -0.9% |
| Sep/RO | 25620* | 17.5 | 35.0% | |
| Sep/PA | 29530* | 17.9 | 35.1% | 0.2% |
| **WET WATER YEAR (1997)** | | | | |
| June/RO | 169160* | 13.4* | 100.0% | |
| June/PA | 142200* | 13.2* | 100.0% | 0.0% |
| July/RO | 58950 | 18.7 | 51.4% | |
| July/PA | 58720 | 18.7 | 51.3% | -0.3% |
| Aug/RO | 32440 | 18.2 | 35.1% | |
| Aug/PA | 38180 | 18.5 | 37.3% | 6.2% |
| Sept/RO | 32090 | 16.8 | 44.9% | |
| Sept/PA | 35820 | 17.1 | 45.5% | 1.5% |
| **DRY WATER YEAR (2000)** | | | | |
| June/RO | 65950 | 14.9* | 83.8% | |
| June/PA | 63230 | 14.8* | 82.5% | -1.6% |
| July/RO | 32160 | 17.1 | 42.8% | |
| July/PA | 36430 | 17.5 | 43.1% | 0.8% |
| Aug/RO | 19440* | 16.8 | 35.4% | |
| Aug/PA | 23670* | 17.8 | 31.4% | -11.2% |
| Sep/RO | 22900* | 17.4 | 33.7% | |
| Sep/ PA | 25880* | 17.6 | 34.5% | 2.4% |

* Either water temperature or flow values are outside of the range of values used in developing the regression model. The estimated survivals are therefore extrapolations beyond the range of the empirical data. Such results are accurate only if the regression function which fits the past observations of the independent variable (i.e., water temperature or flow) is appropriate over a wider range of the variable. NMFS recognizes this limitation and places low confidence in these extrapolated results.

### 6.3.2.5 Net Effect on Essential Features of Critical Habitat

The PA is likely to improve designated critical habitat throughout the entire period of this Opinion under the Environmental Baseline Approach. The essential element of safe passage in the juvenile migration corridor would be improved under the PA because the survival past lower Snake and Columbia River projects would be higher than in the environmental baseline (reference operation). This is principally due to increased summer flows and juvenile survival, as shown in empirical reach survival studies. Increasing flow decreases travel time, which is thought to reduce juvenile susceptibility to predation, disease, and thermal stress. The improvement in safe passage is indicated by the difference in survival estimates, for the small proportion of fish that migrate entirely in-river, between the reference and proposed operations

(Tables 6-7 and 6-9). Water quality would be reduced with respect to summer water temperatures in the lower Snake River. Summer water temperatures would be increased by a small amount, but when considered within the context of increased summer flows, the overall effect is expected to be beneficial (Section 6.3.2.1). The increase in summer flow would negligibly increase the extent of juvenile shallow-water rearing habitat (essential habitat feature "space") in the estuary, and this would have a negligible positive effect on SR fall chinook salmon that rear in the lower Columbia River and estuary. Habitat conditions for spawning and rearing habitat are expected to either remain unchanged or improve, because flow is expected to be higher during September in comparison to reference operation flows. The proposed action would have a negligible adverse effect on water quality (temperature) for adults migrating downstream of Lower Granite Dam.

Under the Listing Conditions Approach, the PA is not likely to negatively alter essential features of critical habitat from conditions existing at the time of listing. The levels of safe passage, estuarine rearing habitat space, and water quality in both the near and long-term are at least as high as those in 1992, when this ESU was listed.

Effects on the essential features of critical habitat that would occur over the long-term would be similar to those described above for the short-term.

### 6.3.3 Upper Columbia River Spring Chinook Salmon

#### 6.3.3.1 Habitat Function

As described in Section 6.2, the USBR's proposed operations, when compared with the reference operation, are expected to have a negligible effect on habitat function with respect to water quantity, water velocity, and water quality during the spring period when juvenile and adult UCR spring chinook salmon migrate through the action area. UCR spring chinook salmon juveniles do not enter the action area until they reach the McNary pool. Adult UCR spring chinook salmon are similarly influenced by the PA from the mouth of the Columbia River to the head of the McNary pool.

The PA's effects on habitat used by yearling migrants in this reach are described in Section 6.3.1.1.

USBR's proposed actions are expected to have only a minor effect on the quantity and quality of juvenile migration and rearing habitat in the Columbia River estuary and plume during the spring when UCR spring chinook salmon are in these areas. Habitat effects in the estuary are essentially the same as those described for SR spring/summer chinook salmon in Section 6.3.1.1

#### 6.3.3.2 Mainstem Dam and Reservoir Passage Survival - SIMPAS Results

**6.3.3.2.1 Near-term**. SIMPAS modeling results indicate that the PA would reduce in-river survival of juvenile UCR spring chinook salmon between McNary Dam and Bonneville Dam by a negligible amount (average -0.2%, range -1 to 1%) (Table 6-7).

No reduction in adult survival is expected as a result of the PA.

**6.3.3.2.2 Long-term**. By 2014, with all of the expected long-term system configuration improvements to the mainstem FCRPS dams in place, the relative in-river survival difference for UCR spring chinook salmon between the USBR's PA and the reference operation would be a very low survival change (average -0.5%, range -0.9% to -0.2%) (Table 6-9).

Adult survival would remain unchanged by the PA.

### 6.3.4 Upper Willamette River Chinook Salmon

The PA is expected to have little or no effect on UWR chinook salmon, compared to the environmental baseline, because use of the action area is low and this ESU does not pass any FCRPS projects. Changes in the lower Columbia River (downstream from Bonneville Dam) and the Columbia estuary and plume are expected to be negligible in most years.

#### 6.3.4.1 Habitat Function

UWR spring chinook salmon display predominantly a stream-type life history strategy like that of SR spring/summer chinook salmon, but some emigrants are subyearlings and thus presumably ocean-type fish. Proposed USBR operations would have only a negligible effect on the quantity and quality of juvenile migration and rearing habitat in the Columbia River estuary and plume during the spring, when yearling UWR spring chinook salmon are in these areas. Habitat effects in the estuary are essentially the same as those described for SR spring/summer chinook salmon in Section 6.3. Those UWR chinook salmon that exhibit an ocean-type life history strategy probably make use of shallow-water habitat in the upper tidally influenced and lower estuary, and then expand into deeper water habitat as they mature (Fresh et al. 2004). To the extent that UWR chinook salmon rear in the estuary during the summer, when proposed flows are somewhat higher than environmental baseline flows, their habitat would be increased.

The PA is expected to result in a negligible adverse effect (i.e., close to zero) on survival of UWR chinook salmon through the estuary compared to that under the environmental baseline (reference operation).

### 6.3.5 Lower Columbia River Chinook Salmon

Juvenile LCR chinook salmon migrate as both yearlings and subyearlings, depending upon the population. Similarly, adults return to spawn in both the spring and fall. Their use of the action area includes adult migration and limited mainstem spawning, and juvenile rearing and migration. Both stream-type and ocean-type life histories are included in this ESU.

#### 6.3.5.1 Habitat Function

For spring-run populations with yearling juvenile migrants, the primary mainstem and estuary habitat differences between the proposed USBR operations and the environmental baseline are expected to be minor, as described in Section 6.3.1.1 for SR spring/summer chinook salmon.

Most LCR chinook populations are fall-run, with subyearling juveniles that migrate during the spring and summer. The primary mainstem, estuary, and plume habitat differences between the reference operation and the proposed action are expected to be similar to those described in Section 6.3.2.1 for SR fall chinook salmon. Like SR fall chinook salmon, LCR chinook salmon are dependent upon shallow-water rearing areas (Fresh et al. 2004). To the extent that LCR chinook salmon rear in the estuary during the summer when proposed flows are somewhat higher than environmental baseline flows, their habitat will be increased.

#### 6.3.5.2 Mainstem Dam and Reservoir Passage Survival - SIMPAS Results

**6.3.5.2.1 Near-term.** Most populations of LCR chinook salmon originate below Bonneville Dam and do not migrate past FCRPS hydro projects. However, two populations (Hood River and Upper Gorge) that are in two of the six major population groups (Gorge Spring-Run and Gorge Fall-Run, respectively) migrate through the Bonneville Dam and pool.

SIMPAS modeling results indicate that the PA would reduce the relative survival, compared to the reference operation, of the single population of yearling-type LCR chinook salmon that migrates past Bonneville Dam by a negligible amount (average -0.1%, range -0.2% to 0%) (Table 6-7).

No quantitative estimates are available to determine the PA's effect on the survival of the three populations of juvenile LCR chinook salmon that migrate past Bonneville Dam as subyearlings. Survival rates would likely be no higher than that of SR fall chinook salmon, which also migrate as subyearlings, but pass Bonneville Dam at a larger size. SIMPAS modeling results indicate that relative survival under the PA, compared to the reference operation, would at least have a negligible beneficial effect on the survival rate of these fish (average +0.2%, range 0% to +0.3%) (Table 6.7).

No difference in the survival of adult fall-run chinook salmon through Bonneville Dam and pool is expected between the reference operation and the PA (Table 6-7).

***Cascade Spring-Run MPG***. This major population group originates below Bonneville Dam and rears primarily in streams, so there is no effect of the PA on this MPG compared with the reference operation.

***Cascade Fall-Run, Cascade Late Fall-Run, and Coast Fall-Run MPGs***. These three major population groups originate below Bonneville Dam and use the estuary for rearing. There is a negligible improvement between the reference operation and the PA for this MPG due to somewhat higher summer flows and negligibly more rearing habitat under the PA.

***Gorge Spring-Run MPG***. This major population group originates upstream of Bonneville Dam and migrates through the Bonneville Dam and pool. SIMPAS modeling results indicate there is likely to be a negligible relative survival difference between the reference operation and the PA passing the Bonneville project.

***Gorge Fall MPG***. This major population group originates upstream of Bonneville Dam, migrates through Bonneville pool and dam, and uses the estuary for rearing. SIMPAS modeling results indicate that relative survival under the PA, compared to the reference operation, would have at least a negligible beneficial effect on passage survival and a negligible positive effect on shallow-water rearing habitat in the estuary, compared to the reference operation.

**6.3.5.2.2 Long-term**. SIMPAS modeling results indicate that the PA would reduce the relative survival of the single population of yearling-type LCR chinook salmon that migrates past Bonneville Dam by a negligible amount (average -0.2%, range -0.2% to -0.1%) compared to the reference operation (Table 6-9).

SIMPAS modeling results indicate that the PA would have a negligible beneficial effect on survival for the three populations of juvenile LCR chinook salmon that migrate past Bonneville Dam as subyearlings (average +0.2%, range 0% to +0.3) (Table 6-9).

No reduction in adult survival for either spring- or fall-run LCR chinook salmon is expected as a result of the PA.

Effects on the major population groups would be the same as described for the near-term.

### 6.3.6 Snake River Steelhead

#### 6.3.6.1 Habitat Function

Effects of the PA on habitat function are expected to be very similar to those described for SR spring/summer chinook salmon in Section 6.3.1.1. These effects would be minor.

#### 6.3.6.2 Mainstem Dam and Reservoir Passage Survival - SIMPAS Results

**6.3.6.2.1 Near-term**. SIMPAS modeling results indicate that the PA would reduce the relative system survival of the juvenile SR steelhead through the action area by a negligible amount, compared to the reference operation (average -0.3%, range -3% to +11%). The system survival estimate includes direct survival and differential post-Bonneville survival (D) of transported fish. The relative survival for fish that remain in-river through the Lower Granite to Bonneville reach would be reduced by a medium amount (average -3%, range -11% to -0.4%) (Table 6-7). The effect is much smaller on system survival because a large proportion, ranging from approximately 60% to 90%, of juvenile SR steelhead migrants are collected and transported past FCRPS dams. The mortality associated with PA is expected to affect all populations of SR steelhead equally.

No reduction in adult survival is expected as a result of the PA.

**6.3.6.2.2 Long-term**. By 2014, with all the expected long-term system configuration improvement to the FCRPS in place, the relative system survival difference between the USBR's PA and the reference operation would be no effect (average 0%, range -2% - +10%). The estimated relative reduction in in-river survival for SR steelhead would be medium (average -

3%, range -11% to -0.6%) (Table 6-9). The effect is much smaller on system survival because a large proportion, ranging from approximately 60 to 90%, of juvenile SR steelhead migrants are collected and transported past FCRPS . Note that system configuration parameter changes assumed for SR steelhead for the long-term proposed action are similar to those of SR spring/summer chinook salmon, identified in Section 6.3.1.2.2.

Adult survival would remain unchanged under the PA.

### 6.3.7 Upper Columbia River Steelhead

#### 6.3.7.1 Habitat Function

As described in Section 6.2, the USBR's proposed action operations are expected to have only a minor effect on habitat function with respect to water quantity, water velocity, and water quality during the spring period when juvenile and adult UCR steelhead migrate through the action area. The proposed action operation does reduce the functioning of juvenile migration habitat with respect to safe passage past barriers due to small reductions in spill levels at some mainstem dams, compared to those in the reference operation, in average to below average water years. The magnitude of this habitat modification is not significant, as reflected in the results of quantitative modeling of in-river survival, which are described below.

Proposed USBR operations are expected to have only a minor effect on the quantity and quality of juvenile migration and rearing habitat in the Columbia River estuary and plume during the spring, when UCR spring chinook salmon are in these areas. Habitat effects in the estuary are essentially the same as those described for SR spring/summer chinook salmon in Section 6.3.1.1.

#### 6.3.7.2 Mainstem Dam and Reservoir Passage Survival - SIMPAS Results

**6.3.7.2.1 Near-term**. SIMPAS modeling results indicate that the PA would reduce the relative survival of juvenile UCR steelhead migrating between McNary Dam and Bonneville Dam by a low amount (average -1%, range -3% to -0.4% (Table 6-7). Mortality associated with the PA is expected to affect all populations of UCR steelhead equally.

No reduction in adult survival is expected under the PA when compared to the reference operation.

**6.3.7.2.2 Long-term**. By 2014, with all the expected long-term system configuration improvements to the mainstem FCRPS dams in place, the relative system survival difference for UCR steelhead between the USBR's PA and the reference operation would be low (average -1%, range -3% to -0.3%) (Table 6-9).

Compared to the reference operation, adult survival would remain unchanged under the PA (Table 6-9).

### 6.3.8 Mid-Columbia River Steelhead

#### 6.3.8.1 Habitat Function

As described in Section 6.3.1.1, the USBR's proposed action operations are expected to have only a minor effect on habitat function with respect to water quantity, water velocity, and water quality during the spring period when juvenile and adult MCR steelhead migrate through the action area. The proposed action operation does reduce the functioning of juvenile migration habitat with respect to safe passage past barriers due to small reductions in spill levels at some mainstem dams, compared to those in the reference operation, in average to below average water years. The magnitude of this habitat modification is not significant, as reflected in results of quantitative modeling of in-river survival, which are described below. In higher than average flow years, the PA would reduce the frequency of exceedences of the gas caps, reducing the potential for elevated TDG conditions.

The primary estuary and plume habitat changes associated with the PA are expected to be very similar to those described in Section 6.3.1.1 for SR spring/summer chinook salmon.

#### 6.3.8.2 Mainstem Dam and Reservoir Passage Survival - SIMPAS Results

**6.3.8.2.1 Near-term**. MCR steelhead migrate through one, two, three, or four mainstem Federal hydro projects in the lower Columbia River, depending upon the population. SIMPAS modeling results indicate that the PA reduces the relative average survival of juvenile MCR populations by varying amounts, compared to the proposed action, depending how many dams and pools the population passed during its migration (Table 6-7):

- For populations originating above McNary Dam, relative survival would be reduced by a low amount (average -1%, range -3% to -0.4%).

- For populations migrating through the John Day reservoir to Bonneville Dam, relative survival would be reduced by a low amount (average -0.8%, range -2% to -0.1%).

- For the John Day River populations originating between McNary and John Day Dams, relative survival would be reduced by a negligible amount (average -0.4%, range -2% to 0.2%).
- For populations originating between The Dalles and John Day Dams, relative survival would be reduced by a negligible amount (average -0.4%, range -2% to 0.1%).

- For populations originating between Bonneville and The Dalles Dams, relative survival would be reduced by a negligible amount (average -0.2%, range -0.8% to 0.1%).

No reduction in adult survival is expected under the PA when compared to the reference operation.

**6.3.8.2.2 Long-term**. By 2014, with all expected long-term system configuration improvements to the mainstem FCRPS dams implemented, the system survival difference for MCR steelhead between the USBR's PA and the reference operation would reduce the average relative survival of the various juvenile MCR populations of steelhead by varying amounts, depending on how many dams and pools the population passed during its migration (Table 6-9):

- For populations originating above McNary Dam, relative survival would be reduced by a low amount (average -1%, range -3% to -0.3%).
- For populations migrating through the John Day reservoir to Bonneville Dam, relative survival would be reduced by a low amount (average -0.9%, range -2% to -0.3%).
- For the John Day River populations, which enter the action area between McNary and John Day Dams, relative survival would be reduced by a very low amount (average -0.5%, range -2% to 0%).
- For populations originating between The Dalles and John Day Dams, relative survival would be reduced by a very low amount (average -0.5%, range -2% to 0%).
- For populations originating between Bonneville and The Dalles Dams, survival would be reduced by a negligible amount (average -0.3%, range -0.8% to 0%).

When compared to the reference operation, no reduction in adult survival is expected under the PA.

### 6.3.9 Upper Willamette River Steelhead

UWR steelhead enter the Columbia River at its confluence with the Willamette River, so they do not migrate past any mainstem dams. Lower Columbia River and plume habitat conditions are the only factors in the action area of importance to this ESU.

#### 6.3.9.1 Habitat Function

As described in Section 6.3.1.1, the USBR's proposed action operations are expected to have only a minor effect on habitat function with respect to water quantity, water velocity, and water quality during the spring period when juvenile and adult UWR steelhead migrate through the action area. Because this ESU does not pass any FCRPS dams, the only effect on safe passage would be the improvement in TDG conditions downstream from Bonneville Dam in higher than average water years.

The primary estuary and plume habitat changes associated with the PA are expected to be the same as those described in Section 6.3.1.1 for SR spring/summer chinook salmon. Thus, the USBR's PA would have a negligible effect on this ESU.

### 6.3.10 Lower Columbia River Steelhead

#### 6.3.10.1 Habitat Function

As described in Section 6.2, the USBR's proposed action operations are expected to have only a minor effect on habitat function with respect to water quantity, water velocity, and water quality during the spring period when juvenile and adult LCR steelhead migrate through the action area. The proposed operation would reduce the functioning of juvenile migration habitat with respect to safe passage past barriers by slightly reducing dam passage survival. The magnitude of this habitat modification is not significant, as reflected in results of quantitative modeling of in-river survival, which are described below. This effect would be offset in higher than average water years by a reduction in the frequency of exceedances of the gas caps, which reduces the potential for elevated TDG conditions, under the PA compared to the reference operation.

The primary estuary and plume habitat changes associated with the USBR's proposed action operations are expected to be very similar to those described in Section 6.3.1.1 for SR spring/summer chinook salmon.

**6.3.10.1.1 Near-term**. Most LCR steelhead originate below Bonneville Dam and do not migrate through any mainstem FCRPS hydro projects. However, four populations in two major population groups migrate through Bonneville Dam and pool. SIMPAS modeling results indicate that the PA would reduce the relative survival of these four juvenile LCR steelhead populations, compared to the reference operation, by a negligible amount (average -0.2%, range -0.8% to +0.1%) (Table 6-7). The mortality associated with the PA is expected to affect these four populations of LCR steelhead equally.

***Cascade Summer-Run and Coastal Winter-Run MPGs***. These major population groups originate below Bonneville Dam and rear primarily in streams, so there is a negligible difference between the PA and the reference operation for these MPGs.

***Gorge Winter-Run and Gorge Summer-Run MPGs***. Most populations in these major population groups originate upstream of Bonneville Dam and migrate through the Bonneville Dam and pool. There is likely to be a negligible difference in relative passage survival through Bonneville Dam (see narrative of estimated survival results above and Table 6-7).

For the four populations that migrate above Bonneville Dam, no reduction in adult survival through Bonneville Dam and pool is expected under the PA when compared to the reference operation (Table 6-7).

**6.3.10.1.2 Long-term**. By 2014, with all the expected long-term system configuration improvements to the mainstem FCRPS dams implemented, the relative survival difference for LCR Steelhead between the PA and the reference operation would be negligible (average -0.3%, range -0.8% to 0%) (Table 6-9).

Long-term effects on the LCR steelhead major population groups would be the same as described in the near-term.

For the four populations that migrate above Bonneville Dam, no difference in adult survival is expected between the PA and the reference operation (Table 6-9).

### 6.3.11 Columbia River Chum Salmon

#### 6.3.11.1 Habitat Function

Most populations of CR chum salmon originate below Bonneville Dam and do not migrate past any FCRPS projects. However, if there is an extant Upper Gorge population (Section 4.3.11) then some juveniles may migrate through the Bonneville Dam and pool. Juvenile migration through the lower river occurs during the spring, when the USBR's PA flows are somewhat lower than those under the reference operation, so a small negative effect on water quantity and velocity would occur. Spring water quality is unlikely to be appreciably reduced. Rearing chum juveniles would benefit from the reduction in the frequency of involuntary spill events in excess of the Corps' gas caps in the spring during high water years.

Adult migration and spawning occur during the late fall and early winter, when the PA provides slightly lower flows than those associated with the reference operation. However, there is no difference between the PA and the reference operation in the frequency that the November through April 15 seasonal average 125 kcfs flow target would be met for CR chum salmon spawning, incubating, and fry rearing downstream from Bonneville Dam. Under both operations, the November-April 15 seasonal average 125 kcfs flow target is met in all 10 study years. However, over the 50-year simulation record of monthly average flows during the November through mid-April period, the 125 kcfs flow target would be missed 2%-3% more often under the PA than in the reference operation, and the misses tend to be small (Appendix A). Therefore, there is unlikely to be a significant change in the overall functioning of spawning and incubation habitat for the Lower Gorge MPG.

If there is an existing population originating above Bonneville Dam, the PA would slightly improve survival of juvenile CR chum salmon over both the near-term and long-term compared to the reference operation (Tables 6-7 and 6-9). Rearing habitat in the lower Columbia River is likely to be unaffected under the PA during the spring. To the extent that CR chum salmon rear in the estuary during the summer, when proposed flows would be somewhat higher than reference operation flows, the amount of available shallow-water habitat would be negligibly increased. Juvenile chum salmon have a high reliance on shallow-water rearing habitat in the Columbia River estuary (Fresh et al. 2004).

No difference in adult survival through Bonneville Dam and pool between the PA and reference operation is expected.

### 6.3.12 Snake River Sockeye Salmon

#### 6.3.12.1 Habitat Function

Effects of the USBR's PA on habitat function are expected to be nearly identical to those described for SR spring/summer chinook salmon in Section 6.3.1.1.

#### 6.3.12.2 Mainstem Dam and Reservoir Passage Survival - SIMPAS Results

**6.3.12.2.1 Near-term**. Juvenile sockeye salmon are known to be frequently injured during dam passage. Therefore, this ESU may experience mortality that is somewhat greater than the ranges estimated for SR spring/summer chinook salmon and SR steelhead, which have similar passage timing. That is, the magnitude of juvenile passage survival is likely to be less than the estimated survival for SR steelhead and SR spring/summer chinook salmon. However, the relative difference in survival between the PA and the reference operation is likely to be similar to that of ESUs that migrate in the spring as yearlings. Based on the SIMPAS modeling results for SR spring/summer chinook and SR steelhead, the PA is likely to negligibly affect system survival, ranging from a low survival reduction to a medium survival improvement (Table 6-7).

No difference in adult survival is expected between the PA and the reference operation.

**6.3.12.2.2 Long-term.** SIMPAS analysis of the PA's effects under the anticipated long-term FCRPS system configuration on SR spring/summer chinook salmon and SR steelhead, indicates there is likely to be a negligible system survival reduction for juvenile SR sockeye salmon, ranging from a low survival reduction to a medium survival improvement (Table 6-9)).

No difference in adult survival is expected between the PA and the reference operation.

#### 6.3.12.3 Net Effect on Essential Features of Critical Habitat

The PA would negatively affect two essential features of designated critical habitat under the Environmental Baseline Approach (water velocity and safe passage) and beneficially affect a third (water quality). As described in Section 6.12.1 (which references Section 6.3), on average, spring flows under the PA would be about 8 kcfs lower than the spring flows in the reference operation. The lowered flows negligibly reduce water velocity and safe passage, which are essential features of SR sockeye salmon critical habitat. By reducing the frequency of exceedances of gas caps and involuntary spills at FCRPS projects in the migratory corridor during the spring by about 8%, the PA would reduce the frequency of adverse TDG conditions, thereby beneficially affecting water quality for both juvenile and adult spring migrants. No difference in the essential feature of water quality, relative to the temperature requirements of salmon and steelhead, is expected during the spring. Because average water velocities in the impounded river reach vary proportionately with discharge, spring water velocity is expected to be about 8% lower in the Snake River and 3% lower in the Columbia River under the PA, compared to the reference operation. The lower flow and lower velocity are expected to have no effect, or possibly a very small beneficial effect, on adult passage success and survival. As described in Section 6.3.12.2, the effects on juvenile SR sockeye salmon are expected to be somewhat greater than those of juvenile SR spring/summer chinook salmon and SR steelhead. The lower flow and lower velocity are expected to reduce the survival of non-transported juvenile migrants of those species by about 1%-3% (Sections 6.3.1.2 and 6.3.6.2). Considering the entire ESU, including those that are transported, the lower flow would have a negligible effect of on the average system survival rate of juvenile SR sockeye salmon.

Under the Listing Conditions Approach, there is no negative alteration of critical habitat, because the conditions of essential features resulting from the PA will be better than those existing at the time of listing (see Section 5.2.2.1.1). The levels of safe passage in both the near-term and long-term are higher than those in 1991, when this ESU was listed (see Section 5.2.2.1.1).

### 6.3.13 Lower Columbia River Coho Salmon

Most LCR coho salmon originate below Bonneville Dam and do not migrate through any hydro projects. However, two of the three populations in one of the two major population groups (Upper Gorge) migrate through Bonneville Dam and pool.

#### 6.3.13.1 Habitat Function

The primary estuary and plume habitat changes associated with proposed USBR operations are expected to be very similar to those described in Section 6.3.1.1 for SR spring/summer chinook salmon.

For all populations that originate below Bonneville Dam and rear primarily in streams, there is a negligible difference between the PA and the reference operation for these MPGs.

#### 6.3.13.2 Mainstem Dam and Reservoir Passage Survival - SIMPAS Results

**6.3.13.2.1 Near-term**. No empirical survival rate estimates exist for this ESU. No change in survival is expected for the populations originating below Bonneville Dam. For the two populations that originate above Bonneville Dam, the survival rate is likely to be similar to that of other yearling juveniles that migrate through Bonneville Dam and pool during the spring. Assuming that the survival rate is similar to that of yearling LCR chinook salmon, the difference in juvenile survival between the proposed action and reference operation would be a negligible reduction (average -0.1%, ranging from a negligible survival reduction to no effect) (Table 6-7). No difference in adult survival through Bonneville Dam and pool is expected under the PA when compared to the reference operation (Table 6-7).

**6.3.13.2.2 Long-term**. The USBR's PA, evaluated with implementation of all the long-term system configuration improvements, would reduce the relative survival of the two LCR coho salmon populations that migrate through Bonneville Dam and pool, compared to the reference operation, by a negligible amount (average -0.2%, ranging from a negligible effect to almost no effect (Table 6-9).

When compared to the reference operation, no difference in adult survival is expected under the PA (Table 6-9).

# 7. CUMULATIVE EFFECTS

## 7.1 Introduction

Cumulative effects, as defined in 50 CFR 402.02, "are those effects of future State or private activities, not involving Federal activities that are reasonably certain to occur within the action area." Future Federal actions require separate consultations pursuant to Section 7 of the ESA and are therefore not considered here. As indicated in Section 1.2.4 of this Opinion, the consultation regulations require that the effects of the action, in the context of the environmental baseline, be considered together with any cumulative effects when determining jeopardy or adverse modification of critical habitat (see 50 CFR 402.14(g)).

There are two specific directives in this definition. One is that NMFS focus its consideration of cumulative effects on those occurring in the action area, as defined in Section 5.1.1 of this Opinion. The second is that NMFS only consider future State and private actions, not involving Federal activities, that are "reasonably certain to occur." Thus NMFS must "consider the cumulative effects of those actions that are likely to occur, bearing in mind the economic, administrative, or legal hurdles which remain to be cleared." This was explained in the preamble to the final rule adopting the definition and use of cumulative effects in a jeopardy analysis (51 FR 19926 at 19933). The rule also stated that this standard "does not mean that there is a guarantee that an action will occur." Instead, the rule explained that "(f)or State and private actions to be considered in the cumulative effects analysis, there must exist more than a mere possibility that the action may proceed" (id.).

The Consultation Handbook prepared jointly by NMFS and the USFWS (1998) provides an example of a cumulative effects analysis regarding "natural gas development" that was occurring within the action area. "Future natural gas development is a cumulative effect as it is regulated by the State. The frequent occurrence of new drilling sites in the area indicated that this activity was "reasonably certain to occur" in the future. Further, several landowners in the action area had recently signed contracts to sell their mineral rights to gas companies" (NMFS and USFWS 1998, 4-31). Thus, the frequency of occurrence is an additional factor, but not a dispositive factor, in evaluating whether the cumulative effect is reasonably certain to occur.

The significance of the cumulative effects element of the jeopardy and adverse modification of critical habitat analysis is indicated by its function; the effects of the proposed action must be "taken together with cumulative effects" 50 CFR 402.14(g)(4). Thus, when evaluating the future effects of the proposed action, NMFS must consider them against the background of the expected future effects of qualifying State and private activities together with the future effects of the environmental baseline, which also includes the likely future effects of Federal actions that have undergone ESA Section 7(a)(2) analysis (Section 1.2.2). What this also means, of course, is that NMFS is not to consider the effects of any future State and private activities that are not "reasonably certain to occur," or that are occurring outside the action area.

The analysis in this chapter, therefore, is first to determine, on the available record, what future State and private activities are reasonably certain to occur in the action area and then to consider how those activities are likely to change the continuing effects of the environmental baseline.

The overall objective of the analysis of the environmental baseline and cumulative effects is to get a picture of the conditions in the action area that are likely to occur without the proposed action and, therefore, to which the effects of the action would be added.

## 7.2 Non-Federal Water Use

The State of Idaho (Section 5.1.1) administers water resource allocation within its borders. Water development currently consumes a substantial fraction of total Columbia and Snake River flows. Roughly 97% of the water consumed in Idaho is used for irrigated agriculture, and much of the streamflow depletion occurs in the spring and summer growing season which overlaps the juvenile salmon migration season. For example, at Brownlee Reservoir, upstream water use reduces average annual flows by about 6 million acre-feet (Maf), about a third of native flows (USBR 1999). About 2 Maf of this amount is associated with USBR's PA (USBR 2004). The remaining 4 Maf is consumed in non-Federal water uses.[40] At Lower Granite Dam, upstream water developments consume about 6.4 Maf, with about 4.4 Maf due to non-Federal water uses.

## 7.3 Water Quality

Throughout the action area (Section 5.1.1), the States are expected to develop and implement TMDLs to improve water quality. The States of Idaho, Oregon, and Washington are under court order to develop TMDL management plans for each of their 303(d) water-quality limited streams, including the mainstem Snake and Columbia Rivers. EPA has entered into an agreement to work with, and provide support to, each of the three States in development of the mainstem temperature TMDLs, which are under court order to be completed on a strict schedule. Although these State TMDL efforts should help improve water temperatures for listed species in the long-term, future implementation of TMDLs is not sufficiently certain for this to qualify as a cumulative effect.

## 7.4 River and Estuary Habitat

The Columbia River Estuary and mainstem are part of the Federal Navigation System, providing deep-draft navigation upstream to the Ports of Portland and Vancouver. Most future actions in this area will have a Federal nexus and thus would require ESA consultation. Accordingly, future actions concerning channel maintenance and dredging are considered environmental baseline for this consultation rather than under cumulative effects.

## 7.5 State Managed Recreational Fisheries

The States of Idaho, Oregon, and Washington conduct recreational steelhead fisheries in tributaries to the Snake River that target marked hatchery fish. Incidental mortality from the catch and release of unmarked listed steelhead is estimated at 3.2% in Idaho. Recreational fisheries for spring/summer chinook salmon in Idaho are managed based on the number of natural-origin spring chinook salmon that escape above Lower Granite Dam (Table 7-1).

[40]These two figures, 6 Maf of average annual consumption and the 2 Maf average flow reduction due to USBR's proposed action, are from separate models and may not be wholly compatible. Therefore, the 4 Maf in average annual non-Federal water consumption upstream from Brownlee Reservoir should be viewed as a rough estimate.

**Table 7-1**. Expected harvest rates for listed Snake River spring/summer chinook salmon in Idaho recreational fisheries

| Lower Granite Dam Predicted Return of Naturally Produced Listed Spring Chinook | Maximum Percentage of Naturally Produced Spring Chinook Mortality for Idaho Recreational Fishery | Range of Potential Incidental Mortalities (Number of Fish) | Estimated Total Take (catch and release) |
|---|---|---|---|
| < 2,800 | 0% | 0 | - |
| 2,800 to 4,500 | 0.25% | 7 to 11 | 70 to 110 |
| 4,501 to 10,000 | 0.5% | 22 to 50 | 220 to 500 |
| 10,001 to 15,000 | 0.75% | 75 to 112 | 750 to 1,120 |
| 15,001 to 20,000 | 1.0% | 150 to 200 | 1,500 to 2,000 |
| 20,001 to 25,000 | 1.5% | 300 to 375 | 3,000 to 3,750 |
| > 25,000 | 2.0% | >500 | >5,000 |

# 8. CONCLUSIONS

## 8.1 Approach

The analysis in the preceding sections of this Opinion forms the basis for NMFS' conclusions as to whether the proposed action, the ongoing operation and maintenance of 12 Federal irrigation projects and related facilities located in the Snake River Basin upstream of Brownlee Reservoir, Idaho, identified in Tables 1-2 through 1-4, satisfies the standards of ESA Section 7(a)(2). To do so, the USBR must ensure that its proposed action is not likely to jeopardize the continued existence of any listed species, or destroy or adversely modify the designated critical habitat of such species. Section 4 of this Opinion defines the biological requirements and the current range-wide status of each of the 12 listed salmonid species and 1 species proposed for listing. Section 5 evaluates the relevance of the environmental baseline to each species' current status. Section 6 details the likely effects of the proposed action on the species and major population groups in the action area across their range and life cycle, and on designated critical habitat. Section 7 considers the cumulative effects of relevant non-Federal actions reasonably certain to occur within the action area. On the basis of this information and analysis, NMFS draws its conclusions about the effects of the USBR's proposed action on the likelihood of both the survival and recovery of the 12 listed and 1 proposed species of Columbia River salmonids, as well as the effects on critical habitat.

### 8.1.1 Jeopardy Analysis

As discussed in Section 1.2.5 of this Opinion, for the jeopardy analysis NMFS must determine whether any reductions of the species' productivity, numbers, or distribution caused by the proposed action reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the listed species.[41] A reduction in the likelihood of both survival and recovery cannot occur if there is no net reduction in the productivity, numbers, or distribution of that ESU,[42] consistent with the regulatory definition of "jeopardize the continued existence" (50 CFR 402.02). Thus, where the analysis in Section 6 indicates that there are not likely to be any net adverse effects to an ESU from the proposed action, NMFS' conclusion will necessarily be that the action is not likely to jeopardize the ESU's continued existence. NMFS nevertheless reviews the factors relevant to the "appreciable reduction" and "adverse modification" determinations for that ESU to provide the full context for this analysis.

The information available to NMFS for this determination is both quantitative and qualitative. For some species, such as SR spring/summer chinook salmon, the available information includes substantial quantitative data based on empirical observations. For other species, such as SR sockeye salmon and several lower river ESUs, the available information is largely qualitative, based on the best professional judgment of knowledgeable scientists. Despite an increasing trend toward a more quantitative understanding of the critical life signs for these fish, critical uncertainties limit NMFS' ability to project future conditions and effects. As a result, no

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[41] Similarly, for the critical habitat determination, if there is no net adverse alteration of any essential features of critical habitat, there can be no adverse modification of that habitat.

[42] An ESU is a distinctive group of Pacific salmon or steelhead. NMFS considers an ESU a "species" under the ESA.

absolute numerical indices are available for any of these stocks on which NMFS can base determinations about jeopardy or the adverse modification of critical habitat (the Section 7(a)(2) standards). Ultimately, for all 13 ESUs, NMFS' conclusions are qualitative judgments based on the best quantitative and qualitative information available for each species.

As described in Section 1.2.5 and Section 6, NMFS considers the effects of an action on an ESU by first considering the effects on individual populations, then on major population groups identified by TRTs, and finally on the ESU as a whole. Effects on populations and major population groups were described in Section 6. In judging whether a reduction in the numbers, productivity, or distribution of an ESU constitutes an appreciable reduction in the likelihood of the ESU's survival and recovery, NMFS considers the following factors:

***Number of MPGs in the ESU.*** ESUs with only one or two major population groups are more likely than ESUs with several major population groups to be reliant on individual populations for recovery or even continued survival (e.g., in the face of major catastrophic events). The smaller the number of major population groups in an ESU, the more likely that a reduction in numbers, productivity, or distribution of one or more groups would constitute an appreciable reduction in the ESU's likelihood of survival and recovery.

***Proportion of MPGs with Reduced Numbers, Productivity, or Distribution.*** The higher the percentage of major population groups in an ESU with a reduction in numbers, productivity, or distribution, the more likely this would constitute an appreciable reduction in the ESU's likelihood of survival and recovery. Conversely, the smaller the proportion of groups with an adverse effect, the less likely there would be an appreciable reduction.

***Magnitude of the Reduction for Affected MPGs.*** A large reduction in numbers, productivity, or distribution for the affected population groups would be more likely than a small reduction to constitute an appreciable reduction in the ESU's likelihood of survival and recovery. As described in Section 6, in determining the magnitude of the reduction, it is relevant to consider the relative timing of adverse and beneficial components of the proposed action.

***Range-wide Status of the ESU.*** An endangered ESU would presumably have less capacity for reduction in numbers, productivity, or distribution than a threatened ESU. Similarly, an endangered or threatened ESU that has been declining significantly in recent years would have less capacity for reduction in numbers, productivity, or distribution than an ESU with an increasing population trend. Therefore, it is more likely that a reduction will be considered "appreciable" for endangered than for threatened ESUs and for declining rather than relatively stable or increasing ESUs.

If the beneficial effects of some components of the proposed action will be delayed relative to the proposed action's adverse effects, NMFS must consider the status and viability of the population during the lag period. There would be an appreciable reduction in the likelihood of survival and recovery if population abundance or productivity were too low during the lag period to respond to later beneficial effects.

***Status of the ESU in the Action Area (Environmental Baseline).*** The extent to which an ESU's biological requirements are not being fully met within the action area is relevant to that ESU's capacity to tolerate additional similar adverse effects. The extent of the action area relative to the range-wide distribution of the ESU is also relevant. The greater the proportion of the range of the ESU represented by the action area, the more significant is the status of the ESU within the range to the "appreciable reduction" determination. In summary, NMFS would be more likely to conclude that a reduction in numbers, productivity, or distribution is an appreciable reduction in the likelihood of both survival and recovery if the status of the ESU in the action area is poor relative to its biological requirements, and if the action area represents a significant proportion of the ESU's range.

***Impact of Cumulative Effects on the Status of the ESU in the Action Area.*** NMFS must consider the influence of non-Federal actions that are reasonably certain to occur in the action area. The key question is whether inclusion of cumulative effects modifies the characterization of the status of an ESU in the action area.

### 8.1.2 Analysis of Adverse Modification of Critical Habitat

If NMFS determines in Section 6 that the proposed action alters an essential feature of designated critical habitat, NMFS then evaluates whether the alteration would constitute the destruction or adverse modification of designated critical habitat by appreciably diminishing the value of critical habitat for survival or recovery. In determining whether an alteration of an essential feature of critical habitat would also appreciably diminish the value of critical habitat for survival or recovery, NMFS considers the magnitude and duration of the alteration, the condition of critical habitat in the action area under the environmental baseline and cumulative effects, the likely purpose of the affected essential feature for survival and recovery, and the status of the ESU across its range and within the action area. As described in Section 8.1.1 for the jeopardy analysis, there can be no adverse modification of designated critical habitat if there is no net alteration of essential features.

### 8.1.3 Summary of Conclusions for All ESUs

Conclusions for the 13 ESUs are summarized in Table 8-1. Details regarding those conclusions are discussed in Sections 8.2 through 8.14.

**Table 8-1.** Summary of conclusions.

| ESU | ESU Net Effect - Change in Numbers, Reproduction, or Distribution? | ESU Jeopardy Determination - Appreciable Reduction in Likelihood of Survival and Recovery? | ESU Adverse Modification Determination |
|---|---|---|---|
| SR Spring/ Summer Chinook | Reduce | Not likely to jeopardize | Not likely to adversely modify |
| SR Fall Chinook | Increase | Not likely to jeopardize | Not likely to adversely modify |
| UCR Spring Chinook | Reduce | Not likely to jeopardize | N/A |
| UWR Chinook | No Change | Not likely to jeopardize | N/A |
| LCR Chinook | Reduce | Not likely to jeopardize | N/A |
| SR Steelhead | Reduce | Not likely to jeopardize | N/A |
| UCR Steelhead | Reduce | Not likely to jeopardize | N/A |
| MCR Steelhead | Reduce | Not likely to jeopardize | N/A |
| UWR Steelhead | No Change | Not likely to jeopardize | N/A |
| LCR Steelhead | Reduce | Not likely to jeopardize | N/A |
| CR Chum | Reduce | Not likely to jeopardize | N/A |
| SR Sockeye | Reduce | Not likely to jeopardize | Not likely to adversely modify |
| LCR Coho | Reduce | Not likely to jeopardize | N/A |

## 8.2 SR Spring/Summer Chinook Salmon

After reviewing the current status of SR spring/summer chinook salmon, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects in the action area, it is NMFS' opinion that the proposed action is not likely to jeopardize the continued existence of this species or adversely modify or destroy designated critical habitat.

***Magnitude of Reduction(s):*** Based on NMFS' dam-passage survival analysis, in both the near and long-term, the proposed action would have a low adverse effect on the small proportion of in-river juvenile migrants (i.e., fish that are not transported) and a negligible effect on system survival, which includes transported and in-river migrants. These effects are most notable in below average water years (e.g., the modeling showed that during 2000, system survival under the proposed action would be 2.5% lower than survival under the reference operation). However, during higher flow years, the proposed action would increase survival compared to the reference operation (e.g., by 0.5% in 2002). The differences in spring flows between the proposed and reference operations would result in small to negligible differences in mainstem and estuary habitats below Bonneville Dam in both the near- and long-term periods. Additionally, by storing water during the spring freshet, the proposed action would benefit juvenile and adult spring migrants by reducing the frequency (by about 8%) and magnitude of involuntary spills that create TDG conditions above 120% saturation. The proposed action is not expected to have an adverse effect on adult passage survival. In summary, the overall quantitative and qualitative effect of the proposed action on the entire SR spring/summer chinook salmon ESU in the near- and long-term periods would be negligible.

***Number of MPGs:*** The presence of five major population groups in this ESU (Section 4) makes it is less likely that any single group is significant for this ESU's viability, compared to ESUs with fewer major population groups.

***Proportion of MPG Reduced:*** All SR spring/summer chinook salmon population groups use the lower Snake and the Columbia River migratory corridors and would be equally affected by the proposed action.

***Range-wide Status of the ESU:*** As described in Section 4, this ESU is a threatened species. The BRT reported that, for the return years 1987 through 2001, most populations experienced long-term declines, but short-term trends (1997 through 2001) were positive for many populations. Short-term productivity trends for the majority of the natural production areas in the ESU are at or above replacement. Dam counts and preliminary spawner surveys also indicate higher than average abundance in 2002 and 2003. The recent ten-year average is about twice the previous ten-year average for combined hatchery and wild adults passing Lower Granite Dam. The BRT concluded that the natural component of the ESU had moderately high risk in the abundance and productivity VSP categories and comparatively low risk for spatial structure and diversity. NMFS' June 14, 2004, Status Review and proposed listing determinations for salmon and steelhead indicated that SR spring/summer chinook salmon artificial production programs provide benefits to ESU abundance, spatial structure, and diversity, but have neutral or uncertain effects on ESU productivity. Collectively, hatchery programs do not substantially reduce the long-term extinction risk of the ESU. However, the existing safety net program is effective at reducing the short-term risk of extinction (see Section 6.3.2.3).

***Status of the ESU in the Action Area (Environmental Baseline):*** All of the fish in this ESU pass through at least part of the action area and the status of the ESU in the action area is in large part the same as the range-wide status of the ESU described in Section 4. Adult passage at existing dams is effective. As described in Section 5, the effects of the existence and operation of the FCRPS hydro system and other types of habitat loss, plus harvest and predation in the mainstem, have severely degraded habitat in the juvenile migration corridor. Beginning in the 1980s and especially in the last decade, structural and operational improvements at mainstem FCRPS projects have improved dam-passage survival for juvenile SR spring/summer chinook salmon, and additional improvements are expected under the FCRPS action agencies' 2004 UPA (Corps et al. 2004). However, the mainstem habitat-related biological requirements of juveniles are not being fully met within the action area.

***Cumulative Effects:*** SR spring/summer chinook salmon are affected by non-Federal water withdrawals within the action area. As described in Section 7.2, non-Federal water uses consume about 4 Maf each year between the upstream extent of the action area and Hells Canyon Dam, and the effects of these flow depletions are propagated downstream into the portion of the action area occupied by this ESU.

***Summary:*** There is a mix of high- and low-risk considerations for the SR spring/summer chinook salmon ESU, both range-wide and in the action area. High mortality in the environmental baseline, caused largely by the effects of the existence and operation of the FCRPS hydro system and other types of habitat loss, plus harvest and predation in the mainstem, indicates relatively high risk. However, recent adult returns and short-term productivity trends for the ESU as a whole, which are at or above replacement levels, indicate reduced range-wide risk, at least in the near-term. On average, over both the near and long-term, the proposed action is expected to reduce juvenile system survival by a negligible amount compared to the reference operation, with results ranging from a negligible reduction in above average runoff years to a very low reduction in below-average runoff years. The proposed action is not expected to have an adverse effect on adult passage survival and is likely to improve water quality conditions for juvenile and adult spring migrants during high flow years by reducing the frequency and severity of elevated TDG conditions. Assuming that the range of future hydrologic conditions will be similar to that experienced over the past ten years, and the differences between the proposed action and the reference operation overestimate the potential survival effects of the proposed action (Section 5.2.2), and the negligible effect of the proposed action on the ESU as a whole, and considering the 4 Maf of continuing non-Federal water consumption within the action area (Cumulative Effects), NMFS concludes that the proposed action is not likely to appreciably reduce the likelihood of survival and recovery of the SR spring/summer chinook salmon ESU.

***Critical Habitat:*** As described in Section 6.3.1.3, using the Environmental Baseline Approach, the proposed action would negatively impact the essential habitat features of water velocity and safe passage[43] in the juvenile migration corridor. The reduction in water velocity is the main factor influencing safe passage. The magnitude of the reduction in safe passage (relative to the reference operation) would be "low" (approximately 1% lower survival rate than the reference operation) for the small proportion of the ESU that migrates entirely in-river past eight dams. For the ESU as a whole, the majority of which is barged around five to seven dams, there would be a negligible difference in survival compared to the reference operation. For the reasons stated below, the reduction in flow would not appreciably diminish the value of designated critical habitat for this ESU as it relates to either its survival (because the difference in survival is low and a relatively small proportion of the ESU is actually affected by it) or its recovery (because it would still be possible to operate the system to achieve the rate of safe passage possible under the environmental baseline into the future).

The status of safe passage and other essential features of critical habitat in the juvenile migration corridor under the environmental baseline is poor. The juvenile migration corridor has been greatly modified by the existence of the mainstem FCRPS hydrosystem, reservoirs, streambank

[43]The conservation value of safe passage for a listed species, is survival through the migratory corridor at a rate sufficient to support increasing populations up to at least a recovery abundance level. The in-river survival rate needed for recovery is currently unknown.

development, and non-discretionary hydro operations, as described in Section 5. A significant proportion of the migrating juveniles is transported around most FCRPS dams in order to avoid exposing fish to the baseline passage conditions. No actions that are properly considered cumulative effects are expected to change the status of critical habitat in the juvenile migration corridor. The range-wide status of the ESU is described above. It is characterized by a mixture of a long-term decline in abundance and productivity; short-term improvements in abundance and productivity, especially over the past three to four years; and current abundance levels that are below interim recovery targets.

The question then becomes whether a small diminishment in the "safe passage" characteristic of the in-river critical habitat for SR spring/summer chinook salmon constitutes an appreciable reduction in the value of critical habitat for either survival or recovery of the ESU. In this case, because the in-river survival change indicative of safe passage only affects a relatively small proportion of the total juvenile migrants, given that most juvenile migrants are transported, NMFS concludes that the effect on the critical habitat, while negative, would not appreciably reduce the value of that habitat as it relates to the survival of this ESU.

When considering whether the alteration of safe passage by the proposed action appreciably diminishes the value of critical habitat for recovery, it is relevant to consider the future potential for critical habitat to meet the recovery needs of this ESU. Does the proposed action reduce the existing ability of the habitat under the environmental baseline to provide safe passage? In this case, the reduction in safe passage is due to an operation that provides flow rates lower than those in the reference operation during the spring, in order to provide flow rates higher than those in the reference operation in the summer to benefit another species of listed fish (i.e., SR fall chinook salmon). The proposed operation, however, does not reduce the availability of stored water in the spring in subsequent years, should the priority for release timing change in the future. Since the capacity of critical habitat to safely pass fish is not reduced, the proposed action does not appreciably diminish the value of the critical habitat for recovery.

After considering all of these factors, NMFS concludes that the USBR's proposed action would not be likely to adversely modify or destroy designated critical habitat for this ESU under the Environmental Baseline Approach.

Under the Listing Condition Approach applied in Section 6.3.1.3, there is no adverse modification or destruction of critical habitat possible because there is not likely to be any alteration of essential features of critical habitat below their condition at the time this ESU was listed (i.e., in 1992).

## 8.3 SR Fall Chinook Salmon

After reviewing the current status of SR fall chinook salmon, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects in the action area, it is NMFS' opinion that the proposed action is not likely to jeopardize the continued existence of this species or adversely modify or destroy designated critical habitat.

***Magnitude of Reduction(s):*** As described in Section 6.3.2, the proposed action is expected to result in an overall improvement in conditions for SR fall chinook salmon (water quantity and the availability of rearing habitat below Bonneville Dam) in both the near- and long-term periods. The difference between summer flows (about 3 kcfs) would result in a negligible increase under the proposed action in the amount of shallow-water, low-velocity rearing habitat, which is used by subyearling migrants in the mainstem below Bonneville Dam and in the estuary, compared to the reference operation. Average monthly temperatures would increase from 0.2°C to 1.0ºC at Lower Granite during July and August, varying with water year (Section 6.2.2), although this may be due, in part, to a modeling artifact (see footnote to Section 6.3.2.1). The proposed action would also have a negligible adverse effect on temperature-related habitat conditions for adults migrating upstream of Lower Granite Dam.

***Number of MPGs:*** There is only one population and therefore one major population group in this ESU (Section 4), which makes it significant for this ESU's viability.

***Proportion of MPGs Reduced:*** As discussed above, there is only one major population group in the ESU and the proposed action would beneficially affect this population.

***Range-wide Status of the ESU:*** As described in Section 4, this ESU is a threatened species. The BRT reported that, through 2001, the natural component of this ESU had experienced long-term declines, but the short-term trend (1997 to 2001) was positive. The June 14, 2004, Status Review indicated that, depending upon the assumption made about the likelihood of the progeny of hatchery fish returning as productive adults, long- and short-term trends in productivity are at or above replacement. Dam counts and preliminary spawner surveys also indicate higher than average abundance in 2002 and 2003. In fact, the four-years 2001-2003 have shown the highest returns of naturally produced spawning adults to areas above Lower Granite Dam since the early 1960s, shortly after access to spawning areas above Hells Canyon was lost (Section 4). The BRT was concerned that overall abundance of natural spawners has been low in spite of recent improvements, and concluded that the natural component of the ESU had moderately high risk for all VSP categories. NMFS' June 14, 2004, Status Review and proposed listing determinations for salmon and steelhead indicated that SR fall chinook salmon artificial production programs provide slight benefits to ESU abundance, spatial structure, and diversity, but have neutral or uncertain effects on ESU productivity. Overall, hatchery programs collectively do not substantially reduce the extinction risk of the ESU in total.

***Status of the ESU in the Action Area (Environmental Baseline):*** Since all individuals in this ESU pass through part of the action area, the status of the ESU in the action area is essentially the same as the range-wide status of the ESU described in Section 4. Adult passage at existing dams is effective. As described in Section 5, the effects of the existence and operation of the FCRPS hydro system and other types of habitat loss, plus harvest and predation in the mainstem, have severely degraded habitat in the juvenile migration corridor for this ESU. Beginning in the 1980s and especially in the last decade, structural and operational improvements at mainstem FCRPS projects have improved dam-passage survival for juvenile SR fall chinook salmon, and additional improvements are expected under the FCRPS Action Agencies' 2004 UPA (Corps et al. 2004). However, the mainstem habitat-related biological requirements of juveniles are not being fully met within the action area.

***Cumulative Effects:*** SR fall chinook salmon are affected by non-Federal water withdrawals within the action area. As described in Section 7.2, ongoing non-Federal water uses consume about 4 Maf each year between the upstream extent of the action area and Hells Canyon Dam, and the effects of these flow depletions are propagated downstream into the portion of the action area occupied by this ESU.

***Summary:*** There is a mix of high- and low-risk considerations for the SR fall chinook salmon ESU, both range-wide and in the action area. High mortality in the environmental baseline, caused largely by the effects of the existence and operation of the FCRPS hydro system and other types of habitat loss, plus harvest and predation in the mainstem, indicates relatively high risk. However, recent adult returns and short-term productivity trends for the ESU as a whole, which are at or above replacement levels, indicate reduced range-wide risk, at least in the near-term. On average, over both the near and long-term, the proposed action is expected to increase juvenile system survival compared to the reference operation by a medium amount over a range of D-values and runoff years. It would also negligibly increase the relative amount of shallow-water, low-velocity rearing habitat used by juvenile SR fall chinook salmon in the mainstem below Bonneville Dam and the estuary. The proposed action is expected to adversely affect adult survival upstream of Lower Granite Dam during July and August, with the magnitude of the effect varying by runoff year. Assuming that the range of future hydrologic conditions will be similar to that experienced over the past ten years, and the differences between the proposed action and the reference operation overestimate the potential survival effects of the proposed action (Section 5.2.2), and the low effect of the proposed action on the ESU as a whole, and considering the 4 Maf of continuing non-Federal water consumption within the action area (Cumulative Effects), NMFS concludes that the proposed action is not likely to appreciably reduce the likelihood of survival and recovery of the SR fall chinook salmon ESU.

***Critical Habitat:*** Evaluated using the Environmental Baseline Approach, and as described in Section 6.3.2.5, the proposed action would improve the essential feature of safe passage in the juvenile migration corridor. Due to increased summer flows, juvenile system survival past lower Snake and Columbia River projects would be higher under the proposed action than under the reference operation. The magnitude of the improvement is "medium" (greater than 3% higher survival rate than under the reference operation over a range of D-values and runoff years). The increase in summer flow would negligibly increase the extent of juvenile shallow-water rearing habitat (essential habitat feature "space" in the estuary. The proposed action would have a negligible effect on water quality (temperature) for adults migrating upstream of Lower Granite Dam.

Under the Listing Conditions Approach, the proposed action is not likely to negatively alter essential features of critical habitat from conditions existing at the time of listing. In both the near- and long-term, the levels of "safe passage," estuarine rearing habitat "space," and "water temperature" are at least as high as those in 1992, when this ESU was listed.

## 8.4 UCR Spring Chinook Salmon

After reviewing the current status of UCR spring chinook salmon, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects in the action area, it is NMFS' opinion that the proposed action is not likely to jeopardize the continued existence of this species.

***Magnitude of Reduction(s):*** Based on our juvenile dam-passage survival analysis, the proposed action would have a very low to negligible effect on the entire outmigration in both the near and long-term. These effects would be largest in below-average water years (e.g., modeling showed that in 1994, relative system survival under the proposed action would be 0.3% to 0.9% lower than under the reference operation). However, during other flow years, the proposed action would increase relative survival compared to the reference operation (e.g., by 1.3% in 2003). The differences between spring flows would result in small to negligible differences in mainstem and estuary habitats below Bonneville Dam in the near- and long-term periods. Additionally, by storing water during the spring freshet, the proposed action would benefit juvenile and adult spring migrants by reducing the frequency (by about 8%) and magnitude of involuntary spills that can create TDG conditions above 120% saturation. The proposed action is not expected to have an adverse effect on adult passage survival. In summary, the overall quantitative and qualitative effect of the proposed action on the entire UCR spring chinook salmon ESU would be negligible.

***Number of MPGs:*** There is only one major population group, which is composed of three extant populations, in this ESU (Section 4), so its viability is significant for this ESU's survival and recovery.

***Proportion of MPGs Reduced:*** The proposed action would equally affect all population groups in this ESU (Section 6).

***Range-wide Status of the ESU:*** As described in Section 4, this ESU is an endangered species. The BRT reported that, through 2001, most populations experienced both long-term and short-term declines, but abundance was high in 2001 for all populations. Dam counts and preliminary spawner surveys also indicate generally higher than average abundance of wild stocks in 2002 and 2003. Mean aggregate (wild and hatchery) returns in 2001-2003 are over 1,000% higher than mean aggregate returns during 1996-2000. Aggregate returns also indicate a positive trend in abundance in recent years. The BRT expressed strong concern regarding risk to the natural component of the ESU with respect to the abundance and productivity VSP categories and comparatively less concern over spatial structure and diversity. NMFS' June 14, 2004, Status Review and proposed listing determinations for salmon and steelhead indicated that UCR spring chinook salmon artificial production programs provide benefits to ESU abundance, have no effect on spatial structure, provide benefits relative to preservation of diversity in some instances, and have uncertain effects on ESU productivity. Overall, hatchery programs collectively do not substantially reduce the extinction risk of the ESU.

***Status of the ESU in the Action Area (Environmental Baseline):*** All of the fish in this ESU pass through part of the action area. Adult passage at existing lower Columbia River dams is effective. As described in Section 5, the effects of the existence and operation of the FCRPS hydro system and other types of habitat loss, plus harvest and predation in the mainstem, have severely degraded habitat in the juvenile migration corridor. Beginning in the 1980s and especially in the last decade, structural and operational improvements at mainstem FCRPS projects have improved passage survival for juvenile UCR spring chinook salmon. Additional improvements are expected under the FCRPS Action Agencies' 2004 UPA (Corps et al. 2004). However, the mainstem habitat-related biological requirements of juveniles are not being fully met within the action area.

***Cumulative Effects:*** UCR spring chinook salmon are affected by non-Federal water withdrawals within the action area. As described in Section 7.2, non-Federal water uses consume about 4 Maf each year between the upstream extent of the action area and Hells Canyon Dam, and the effects of these flow depletions are propagated downstream into the portion of the action area occupied by this ESU.

***Summary:*** There is a mix of high- and low-risk considerations for the UCR spring chinook salmon ESU, both range-wide and in the action area. High mortality in the environmental baseline, caused largely by the existence and operation of the FCRPS hydrosystem plus other types of habitat loss and alteration, harvest, and predation in the mainstem indicates relatively high risk. However, recent adult returns and short-term productivity trends for the ESU as a whole, which are at or above replacement levels, indicate reduced range-wide risk, at least in the near-term. On average, the proposed action would reduce juvenile system survival by a negligible amount over the near-term and by a very low amount over the long-term, ranging from a negligible reduction in above-average runoff years to a very low reduction in below-average years. No adverse effects on adult passage survival are expected, and the proposed action is likely to improve water quality conditions for juvenile and adult spring migrants during high flow years by reducing the frequency and severity of elevated TDG conditions. Assuming that the range of future hydrologic conditions will be similar to that experienced over the past ten years, and the differences between the proposed action and the reference operation overestimate the potential survival effects of the proposed action (Section 5.2.2), and the negligible effect of the proposed action on the ESU as a whole, and considering the 4 Maf of continuing non-Federal water consumption within the action area (Cumulative Effects), NMFS concludes that the proposed action is not likely to appreciably reduce the likelihood of survival and recovery of the UCR spring chinook salmon ESU.

### 8.5 UWR Chinook Salmon

After reviewing the current status of UWR chinook salmon, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects in the action area, it is NMFS' opinion that the proposed action is not likely to jeopardize the continued existence of this species.

***Magnitude of Reduction(s):*** The proposed action is not likely to reduce numbers, productivity, diversity, or the distribution of the single major population group (Section 6). This ESU encounters the proposed action's effects only in the Columbia River plume and estuary and in the lower mainstem below the mouth of the Willamette. The effects of the proposed action on habitat conditions in this portion of the action area would be negligible.

***Number of MPGs:*** There is only one major population group, which is composed of seven extant populations, in this ESU (Section 4), so its viability is significant for this ESU's survival and recovery.

***Proportion of MPGs Reduced:*** The proposed action is not likely to reduce numbers, productivity, diversity, or the distribution of the single major population group (Section 6).

***Range-wide Status of the ESU:*** As described in Section 4, this ESU is a threatened species. The BRT reported that it is very difficult to determine trends in abundance and productivity for the natural component of the ESU, because there are no direct estimates of natural-origin spawner abundance. The BRT concluded that the natural component of the ESU had moderately high risk for all four VSP categories. NMFS' June 14, 2004, Status Review and proposed listing determinations for salmon and steelhead indicated that UWR chinook salmon artificial production programs provide slight benefits to ESU abundance and spatial structure but have neutral or uncertain effects on ESU productivity and diversity. Collectively, hatchery programs do not substantially reduce the extinction risk of the ESU.

***Status of the ESU in the Action Area (Environmental Baseline):*** The significant baseline effects of the existence and operation of the Corps' Willamette Project dams and reservoirs, and other types of habitat loss caused by the land use activities considered in NMFS (2004a), are key factors influencing ESU status in the action area.

***Cumulative Effects:*** UWR chinook salmon are affected by non-Federal water withdrawals within the action area. As described in Section 7.2, non-Federal water uses consume about 4 Maf each year between the upstream extent of the action area and Hells Canyon Dam, and some level of the effect of these flow depletions is propagated downstream into the portion of the action area occupied by this ESU.

***Summary:*** Because the proposed action would not result in a net reduction in numbers, reproduction, or distribution compared to the reference operation, the proposed action is not likely to appreciably reduce the likelihood of survival and recovery of the ESU.

## 8.6 LCR Chinook Salmon

After reviewing the current status of LCR chinook salmon, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects in the action area, it is NMFS' opinion that the proposed action is not likely to jeopardize the continued existence of this species.

***Magnitude of Reduction(s):*** Based on our juvenile dam-passage survival analysis, the proposed action would have a negligible effect on the entire outmigration in both the near- and long-term periods, and in all the types of water years modeled. The difference in spring flows between the proposed action and the reference operation would result in small to negligible differences in the availability of mainstem and estuary habitats below Bonneville Dam. On the other hand, summer flows are considerably higher under the proposed action than the reference operation, providing more of the shallow-water, low-velocity rearing habitat used by subyearling migrants. By reducing the frequency (by about 8%) and magnitude of involuntary spills that create TDG conditions above 120% saturation in the migratory corridor during high-water years, the proposed action would benefit both adult and juvenile spring migrants. The proposed action is not expected to have an adverse effect on adult passage survival. In summary, the overall quantitative and qualitative effect of the proposed action on the entire LCR spring chinook salmon ESU would be negligible.

***Number of MPGs:*** The presence of six extant major population groups in this ESU (Section 4) means that the viability of any single group is less likely to significantly affect this ESU's survival and recovery, as compared to ESUs with fewer major population groups.

***Proportion of MPGs Reduced:*** The proposed action would not reduce the numbers, productivity, or distribution of any of the six extant major population groups.

***Range-wide Status of the ESU:*** As described in Section 4, this ESU is a threatened species. The BRT reported that most populations have exhibited pronounced increases in abundance and productivity in recent years, although the abundance of naturally produced spawners is uncertain. Despite recent improvements, long-term trends are below replacement for the majority of populations in the ESU. The BRT concluded that the natural component of the ESU had moderately high risk for all VSP categories. NMFS' June 14, 2004, Status Review and proposed listing determinations for salmon and steelhead indicated that LCR chinook salmon artificial production programs provide slight benefits to ESU abundance, spatial structure, and diversity, but have neutral or uncertain effects on ESU productivity. Overall, hatchery programs collectively do not substantially reduce the extinction risk of the ESU in total.

***Status of the ESU in the Action Area (Environmental Baseline)*****:** All of the fish in this ESU pass through part of the action area. Adult passage at Bonneville Dam, as experienced by individuals from two major population groups, is effective. As described in Section 5, the effects of the existence and operation of the FCRPS hydro system and other types of habitat loss have severely degraded habitat in the juvenile migration corridor. Comparisons of survival estimates for yearling and subyearling LCR chinook salmon between conditions under the reference operation and a free-flowing reach of equal length (Section 5) indicate that the mainstem habitat-related biological requirements of juveniles are not fully met within the action area.

***Cumulative Effects:*** LCR chinook salmon are affected by non-Federal water withdrawals within the action area. As described in Section 7.2, non-Federal water uses consume about 4 Maf each year between the upstream extent of the action area and Hells Canyon Dam, and some level of the effect of these flow depletions is propagated downstream into the portion of the action area occupied by this ESU.

***Summary:*** There is a mix of risk considerations for the LCR chinook salmon ESU, both range-wide and in the action area. Mortality in the environmental baseline, caused in part by the existence of Bonneville Dam and its non-discretionary operations, as well as other types of mainstem habitat loss, indicates a negligible risk to individuals in two of the MPGs. However, recent adult returns and short-term productivity trends for the ESU as a whole, which are at or above replacement levels, indicate reduced range-wide risk, at least in the near-term. On average, over both the near- and long-term, the effect of the proposed action would be to reduce the survival of yearling juvenile migrants originating above Bonneville Dam and to increase the survival of subyearling migrants from above Bonneville Dam by negligible amounts in both above- and below-average runoff years. The proposed action would benefit subyearling migrants by providing more of the shallow water, low velocity habitat used for rearing below Bonneville Dam. No adverse effects on adult passage survival are expected, and the proposed action is likely to improve water quality conditions for juvenile and adult spring migrants during high flow years by reducing the frequency and severity of elevated TDG conditions. Assuming that the range of future hydrologic conditions will be similar to that experienced over the past ten years, and the differences between the proposed action and the reference operation overestimate the potential survival effects of the proposed action (Section 5.2.2), and the negligible effect of the proposed action on the ESU as a whole, and considering the 4 Maf of ongoing consumptive non-Federal water withdrawals within the action area (Cumulative Effects), NMFS concludes that the proposed action is not likely to appreciably reduce the likelihood of survival and recovery of the LCR chinook salmon ESU.

## 8.7 SR Steelhead

After reviewing the current status of SR steelhead, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects in the action area, it is NMFS' opinion that the proposed action is not likely to jeopardize the continued existence of this species.

***Magnitude of Reduction(s):*** Based on NMFS' juvenile dam-passage survival analysis, and compared to the reference operation, the proposed action would have a negligible effect on system survival in both the near and long-term. It would have a medium effect on the survival of in-river migrants. These effects are largest in lower than average water years (e.g., modeling showed that in 2001, a very low water year, relative system survival under the proposed action would be 2.7% less than under the reference operation and the survival of in-river migrants would be 11% less). However, during other flow years, the proposed action would increase relative system survival compared to the proposed action (e.g., 11% in 2000). Additionally, by storing water during the spring freshet, the proposed action would reduce the frequency (by about 8%) and magnitude of involuntary spills that create TDG conditions above 120% saturation. The proposed action would slightly reduce water temperatures in the migratory corridor during spring, which would benefit juvenile and adult steelhead survival. There would be small to negligible effects on mainstem and estuarine habitats below Bonneville Dam, because spring flows under the PA are similar to those under the reference operation. The proposed action is not expected to have an adverse effect on adult passage survival. In summary, the overall effect of the proposed action on the entire SR steelhead ESU would be very low to negligible.

***Number of MPGs:*** The presence of six extant major population groups in this ESU (Section 4) means that the viability of any single group is less likely to significantly affect this ESU's survival and recovery, as compared to ESUs with fewer major population groups.

***Proportion of MPGs Reduced:*** The proposed action would equally affect all SR steelhead major population groups.

***Range-wide Status of the ESU:*** As described in Section 4, this ESU is a threatened species. The BRT reported that, through 2001, available census information indicated mixed trends in abundance and productivity. The BRT concluded that the natural component of the ESU had moderately high risk for the abundance, diversity, and productivity VSP categories and comparatively lower risk for spatial structure. NMFS' June 14, 2004, Status Review and proposed listing determinations for salmon and steelhead indicated that SR steelhead artificial production programs provide slight benefits to ESU abundance and spatial structure, but have neutral or uncertain effects on ESU productivity and diversity. Overall, hatchery programs collectively do not substantially reduce the extinction risk of the ESU.

***Status of the ESU in the Action Area (Environmental Baseline):*** All of the fish in this ESU pass through part of the action area and the status of the ESU in the action area is in large part the same as the range-wide status of the ESU described in Section 4. Adult passage at existing dams is effective. As described in Section 5, the effects of the existence and operation of the FCRPS hydro system and other types of habitat loss, plus harvest and predation in the mainstem, have severely degraded habitat in the juvenile migration corridor. The habitat-related biological requirements of juvenile SR steelhead are not being fully met within the action area. The significant baseline effects of the mainstem FCRPS and USBR projects considered in NMFS (2004a), which are among the key factors influencing ESU status in the action area, are expected to improve as the FCRPS action agencies implement their 2004 UPA (Corps et al. 2004).

***Cumulative Effects:*** SR steelhead are affected by non-Federal water withdrawals within the action area. As described in Section 7.2, non-Federal water uses consume about 4 Maf each year between the upstream extent of the action area and Hells Canyon Dam, and the effects of these flow depletions are propagated downstream into the portion of the action area occupied by this ESU.

***Summary:*** There is a mix of high- and low-risk considerations for the SR steelhead ESU, both range-wide and in the action area. High mortality in the environmental baseline, caused largely by the existence of the mainstem FCRPS hydro system and non-discretionary operations, as well as other types of habitat loss, plus harvest and predation in the mainstem indicates relatively high risk. However, recent adult returns and short-term productivity trends for the ESU as a whole, which are at or above replacement levels, indicate reduced range-wide risk, at least in the near-term. On average, in the near-term, the proposed action is expected to have a negligible effect on juvenile system survival, becoming "no effect" during the long-term period. Juvenile survival effects range from a medium increase in survival in above-average runoff years to a medium decrease in survival in below-average runoff years (in both the near- and long-term periods). The proposed action is not expected to have an adverse effect on adult passage survival, and, in high runoff years, would benefit water quality conditions for juvenile and adult spring migrants by reducing the frequency and severity of adverse TDG conditions. Assuming that the range of future hydrologic conditions will be similar to that experienced over the past ten years, and the differences between the proposed action and the reference operation overestimate the potential survival effects of the proposed action (Section 5.2.2), and the very low to negligible effect of the proposed action on the ESU as a whole, and considering the 4 Maf of continuing non-Federal water consumption within the action area (Cumulative Effects), NMFS concludes that the proposed action is not likely to appreciably reduce the likelihood of survival and recovery of the SR steelhead ESU.

## 8.8 UCR Steelhead

After reviewing the current status of UCR steelhead, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects in the action area, it is NMFS' opinion that the proposed action is not likely to jeopardize the continued existence of this species.

***Magnitude of Reduction(s):*** Based on our juvenile dam-passage survival analysis compared to the reference operation, the proposed action would have a low effect on the entire (in-river) outmigration both in the near and long-term. This effect would be largest in below average water years (e.g., the modeling showed that during 1994, in-river survival under the proposed action would be about 3% lower than under the reference operation). The proposed action is expected to have a negligible effect on mainstem and estuarine habitats below Bonneville Dam because spring flows under the proposed action are similar to those under the reference operation. However, by storing water during the spring freshet, the proposed action would reduce the frequency (by about 8%) and magnitude of involuntary spills that create TDG conditions above 120% saturation, benefiting both juvenile and adult migrants in years with above average runoff. The proposed action is not expected to have an adverse effect on adult passage survival. In summary, the overall quantitative and qualitative effect of the proposed action on the entire UCR steelhead ESU would be very low to negligible.

***Number of MPGs:*** There is only one major population group, composed of four extant populations, in this ESU (Section 4), so its viability is significant for the ESU's survival and recovery.

***Proportion of MPGs Reduced:*** There is only one major population group in this ESU.

***Range-wide Status of the ESU:*** As described in Section 4, this ESU is an endangered species, although in its June 14, 2004, Status Review and proposed listing determination, NMFS has proposed to designate this ESA as threatened. The BRT reported that, through 2000, most populations experienced long-term declines, but abundances were higher in 2001 for all populations. Dam counts and preliminary spawner surveys also indicate higher than average abundance levels in 2002 and 2003. In the 2004 Status Review, NMFS reported that the last two to three years (through 2001) had seen an encouraging increase in the number of naturally produced fish in the UCR steelhead ESU. A preliminary analysis indicates that the slope of the natural-origin population trend increased 9.2% (from 0.97 to 1.06,) when the data for 2001-2003 were added to the 1990-2000 series, reversing the decline and indicating, at least in the short-term, that the run size has been increasing. The BRT found high risk to the natural-origin component of the ESU with respect to the productivity VSP category, but comparatively lower risk for the other categories. NMFS' June 14, 2004, Status Review and proposed listing determinations for salmon and steelhead indicated that UCR steelhead artificial production programs provide benefits to ESU abundance and spatial structure, but have neutral or uncertain effects on ESU productivity and diversity. Overall, hatchery programs collectively mitigate the immediacy of extinction risk of the ESU in-total in the short-term, but the contribution of these programs in the foreseeable future is uncertain.

***Status of the ESU in the Action Area (Environmental Baseline):*** All of the fish in this ESU pass through part of the action area. Adult passage at existing dams in the lower Columbia River is effective. As described in Section 5, the effects of the existence and operation of the FCRPS hydro system and other types of habitat loss in the mainstem have severely degraded habitat in the juvenile migration corridor. Survival is expected to improve as the FCRPS action agencies implement their UPA (Corps et al. 2004), but, at present, the habitat-related biological requirements of juveniles are not fully met within the action area.

***Cumulative Effects:*** UCR steelhead are affected by non-Federal water withdrawals within the action area. As described in Section 7.2, non-Federal water uses consume about 4 Maf each year between the upstream extent of the action area and Hells Canyon Dam, and the effects of these flow depletions are propagated downstream into the portion of the action area occupied by this ESU.

***Summary:*** There is a mix of high- and low-risk considerations for the UCR steelhead ESU, both range-wide and in the action area. High mortality in the environmental baseline, caused largely by the existence and operation of the FCRPS hydro system, plus other types of habitat loss in the mainstem, indicates relatively high risk. However, recent adult returns and short-term productivity trends for the ESU as a whole, which are at or above replacement levels, indicate reduced range-wide risk, at least in the near-term. On average, over both the near and long-term, the effect of the proposed action would be to reduce juvenile survival by a low amount, ranging from a negligible reduction in above-average runoff years to a medium reduction in below-average runoff years. The proposed action is not likely to have an adverse effect on adult passage survival and is likely to improve water quality conditions for juvenile and adult spring migrants during high flow years by reducing the frequency and severity of elevated TDG conditions. Assuming that the range of future hydrologic conditions will be similar to that experienced over the past ten years, and the differences between the proposed action and the reference operation overestimate the potential survival effects of the proposed action (Section 5.2.2), and considering the very low to negligible effect of the proposed action on the ESU as a whole, and considering the 4 Maf of continuing non-Federal water consumption within the action area (Cumulative Effects), NMFS concludes that the proposed action is not likely to appreciably reduce the likelihood of survival and recovery of the UCR steelhead ESU.

## 8.9 MCR Steelhead

After reviewing the current status of MCR steelhead, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects in the action area, it is NMFS' opinion that the proposed action is not likely to jeopardize the continued existence of this species.

***Magnitude of Reduction(s):*** Based on our juvenile dam-passage survival analysis and compared to the reference operation, the proposed action would have a negligible to low adverse effect on juvenile in-river survival, depending on the number of dams and reservoirs passed, in both the near and long-term. These effects would be largest in below-average water years (e.g., the modeling showed that during 1994, in-river survival under the proposed action would be about 2% less than under the reference operation). The proposed action is expected to have a negligible effect on mainstem and estuarine habitats below Bonneville Dam, because spring flows would be similar to those under the reference operation. However, by storing water during the spring freshet, the proposed action would reduce the frequency (by about 8%) and magnitude of involuntary spills that create TDG conditions above 120% saturation, benefiting both juvenile and adult migrants in above average runoff years. The proposed action is not expected to have an adverse effect on adult survival. In summary, the overall quantitative and qualitative effect of the proposed action on the entire MCR steelhead ESU would be very low to negligible.

***Number of MPGs:*** The presence of five major population groups in this ESU (Section 4) means that it is less likely that the viability of any single group is significant for this ESU's survival and recovery, compared to ESUs with fewer major population groups.

***Proportion of MPGs Reduced:*** The proposed action would equally affect all SR steelhead major population groups.

***Range-wide Status of the ESU:*** As described in Section 4, this ESU is a threatened species. The BRT reported that, through 2001, most populations experienced long-term declines and positive short-term trends. In its Status Review, NMFS noted that the abundance of natural populations in the MCR steelhead ESU increased substantially in 2001 over the previous 5 years. The Deschutes and Upper John Day Rivers had recent 5-year mean abundance levels in excess of their respective interim recovery target abundance levels (NMFS 2000). Preliminary results for 2002 indicate that the slope of the population trend for natural-origin fish increased 6.2% (from 0.99 to 1.05) when the data for 2001-2002 were added to the 1990-2000 series, indicating that, at least in the short-term, the natural-origin population has been increasing. The BRT concluded that the natural component of the ESU had moderate risk for all VSP categories, with the greatest relative risk attributed to the ESU abundance category. NMFS' June 14, 2004, Status Review and proposed listing determinations for salmon and steelhead indicated that MCR steelhead artificial production programs provide slight benefits to ESU abundance, a negligible contribution to spatial structure, and neutral or uncertain effects on ESU productivity and diversity. Overall, hatchery programs collectively do not substantially reduce the extinction risk of the ESU.

***Status of the ESU in the Action Area (Environmental Baseline):*** All of the fish in this ESU pass through part of the action area. Adult passage at existing FCRP dams is effective. As described in Section 5, the effects of the existence and operation of the FCRPS hydro system and other types of habitat loss have severely degraded habitat in the juvenile migration corridor. Beginning in the 1980s, and especially in the last decade, structural and operational improvements at FCRPS projects have improved dam-passage survival for juvenile MCR steelhead, and additional improvements are expected under the FCRPS Action Agencies' 2004

UPA (Corps et al. 2004). However, the mainstem habitat-related biological requirements of juveniles are not being fully met with in the action area.

***Cumulative Effects:*** MCR steelhead are affected by non-Federal water withdrawals within the action area. As described in Section 7.2, non-Federal water uses consume about 4 Maf each year between the upstream extent of the action area and Hells Canyon Dam, and the effects of these flow depletions are propagated downstream into the portion of the action area occupied by this ESU.

***Summary:*** There is a mix of high and low risk considerations for the MCR steelhead ESU, both range-wide and in the action area. High mortality in the environmental baseline, caused largely by the existence and operation of the FCRPS hydrosystem and other types of mainstem habitat loss, indicates relatively high risk. However, recent adult returns and short-term productivity trends for the ESU as a whole, which are at or above replacement levels, indicate reduced range-wide risk, at least in the short-term. On average, over both the near and long-term, the proposed action is expected to reduce juvenile survival by a negligible amount for smolts that pass only one dam, and by a low amount for smolts that pass four dams. The proposed action is not expected to have an adverse effect on adult passage survival, and is likely to improve water quality conditions for juvenile and adult spring migrants during high flow years by reducing the frequency and severity of elevated TDG conditions. Assuming that the range of future hydrologic conditions will be similar to that experienced over the past ten years, and the differences between the proposed action and the reference operation overestimate the potential survival effects of the proposed action (Section 5.2.2), and the very low to negligible effect of the proposed action on the ESU as a whole, and considering the 4 Maf of continuing non-Federal water consumption within the action area (Cumulative Effects), NMFS concludes that the proposed action is not likely to appreciably reduce the likelihood of survival and recovery of the MCR steelhead ESU.

## 8.10 UWR Steelhead

After reviewing the current status of UWR steelhead, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects in the action area, it is NMFS' opinion that the proposed action is not likely to jeopardize the continued existence of this species.

***Magnitude of Reduction(s):*** The proposed action is not likely to reduce numbers, productivity, diversity, or the distribution of the single major population group (Section 6). This ESU encounters the proposed action's effects only in the Columbia River plume and estuary and in the lower river below the mouth of the Willamette. The proposed action's effects on habitat conditions in this portion of the action area would be negligible (Section 6).

***Number of MPGs:*** There is only one major population group, composed of seven extant populations, in this ESU (Section 4), which means that its viability is significant for this ESU's survival and recovery.

***Proportion of MPGs Reduced:*** The proposed action is not likely to reduce numbers, productivity, diversity, or the distribution of the single major population group (Section 6).

***Range-wide Status of the ESU:*** As described in Section 4, this ESU is a threatened species. The BRT reported that the ESU experienced significant increases in adult returns in recent years, but all populations in the ESU have experienced long-term declines. The BRT concluded that the natural component of the ESU had moderate risk for all VSP categories.

***Status of the ESU in the Action Area (Environmental Baseline):*** The significant baseline effects of the Corps' Willamette Project dams and reservoirs, and other types of habitat loss caused by land use activities considered in NMFS (2004a), are key factors influencing ESU status in the action area.

***Cumulative Effects:*** UWR steelhead are affected by non-Federal water withdrawals within the action area. As described in Section 7.2, non-Federal water uses consume about 4 Maf each year between the upstream extent of the action area and Hells Canyon Dam, and some level of the effect of these flow depletions is propagated downstream into the portion of the action area occupied by this ESU.

***Summary:*** Because the proposed action would not result in a net reduction in numbers, reproduction, or distribution compared to the reference operation, the proposed action is not likely to appreciably reduce the likelihood of survival and recovery of the ESU.

## 8.11 LCR Steelhead

After reviewing the current status of LCR steelhead, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects in the action area, it is NMFS' opinion that the proposed action is not likely to jeopardize the continued existence of this species.

***Magnitude of Reduction(s):*** Based on our juvenile dam-passage survival analysis, and compared to the reference operation, the proposed action would have a negligible survival effect on all four populations of LCR steelhead originating above Bonneville Dam in both the near and long-term. This effect would be largest in below-average water years (e.g., the modeling showed that during 1994, relative system survival under the proposed action was about 1% less than under the reference operation). The proposed action would have a small to negligible effect on mainstem and estuarine habitats below Bonneville Dam, because spring flows under the proposed action are similar to those under the reference operation. However, by storing water during the spring freshet, the proposed action would reduce the frequency (by about 8%) and magnitude of involuntary spills that create TDG conditions above 120% saturation, benefiting both juvenile and adult spring migrants in years with above average runoff. The proposed action is not expected to have an adverse effect on adult passage survival. In summary, the overall quantitative and qualitative effect of the proposed action on the entire LCR steelhead ESU is likely to be negligible.

***Number of MPGs:*** The presence of four major population groups in this ESU (Section 4) means that the viability of any single group is less likely to significantly affect this ESU's survival and recovery as compared to ESUs with fewer major population groups.

***Proportion of MPGs Reduced:*** The proposed action would negligibly reduce the numbers, productivity, and distribution of two of the four extant major population groups (Section 6).

***Range-wide Status of the ESU:*** As described in Section 4, this ESU is a threatened species. The BRT reported that most populations have experienced both long-term and short-term declines. In its Status Review, NMFS noted that some anadromous populations in the LCR steelhead ESU, particularly summer-run steelhead populations, had shown encouraging increases in abundance in the two to three years ending in 2001. The BRT concluded that the natural component of the ESU had moderate risk for each of the VSP categories. NMFS' June 14, 2004, Status Review and proposed listing determinations for salmon and steelhead indicated that LCR steelhead artificial production programs provide slight benefits to ESU abundance, spatial structure, and diversity, but have neutral or uncertain effects on ESU productivity. Collectively, hatchery programs do not substantially reduce the extinction risk of the ESU.

***Status of the ESU in the Action Area (Environmental Baseline):*** All of the fish in this ESU pass through part of the action area. Adult passage at Bonneville Dam, as experienced by individuals from two major population groups, is effective. As described in Section 5, the effects of the existence and operation of the FCRPS hydro system and other types of habitat loss, plus harvest in the mainstem, have severely degraded habitat in the juvenile migration corridor. Comparisons of survival estimates for yearling LCR steelhead between conditions under the reference operation and a free-flowing river reach of equal length indicate that the mainstem habitat-related biological requirements of juveniles are not fully met within the action area.

***Cumulative Effects:*** LCR steelhead are affected by non-Federal water withdrawals within the action area. As described in Section 7.2, non-Federal water uses consume about 4 Maf each year between the upstream extent of the action area and Hells Canyon Dam, and some level of the effect of these flow depletions is propagated downstream into the portion of the action area occupied by this ESU.

***Summary:*** There is a mix of high- and low-risk considerations for the LCR steelhead ESU, both range-wide and in the action area. High mortality in the environmental baseline, caused in part by the existence of Bonneville Dam and its operations, but also by other types of habitat loss and harvest in the mainstem, indicates some risk. Recent adult returns and short-term productivity trends for the ESU as a whole have declined and are below replacement levels, indicating ongoing range-wide risk, at least in the near-term. On average, over both the near and long-term, the proposed action is expected to reduce the survival of yearling juvenile migrants in the four populations that originate above Bonneville Dam by a negligible amount, compared to the reference operation. This effect would occur in both above and below average runoff years. The proposed action is not expected to have an adverse effect on adult passage survival, and is likely to improve water quality conditions for juvenile and adult spring migrants during high flow years by reducing the frequency and severity of elevated TDG conditions. Assuming that the range of future hydrologic conditions will be similar to that experienced over the past ten years, and the differences between the proposed action and the reference operation overestimate the potential survival effects of the proposed action (Section 5.2.2), and the negligible effect of the proposed action on the ESU as a whole, and considering the 4 Maf of ongoing consumptive non-Federal water withdrawals within the action area (Cumulative Effects), NMFS concludes that the proposed action is not likely to appreciably reduce the likelihood of survival and recovery of the LCR steelhead ESU.

### 8.12 CR Chum Salmon

After reviewing the current status of CR chum salmon, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects in the action area, it is NMFS' opinion that the proposed action is not likely to jeopardize the continued existence of this species.

***Magnitude of Reduction(s):*** The proposed action is not likely to reduce numbers, productivity, diversity, or the distribution of the three major population groups, which enter the action area in the mainstem Columbia River below The Dalles Dam and in the estuary and plume. If juvenile chum are produced in habitat above Bonneville Dam, the proposed action would benefit these subyearling migrants by increasing survival past Bonneville by a negligible amount in both the near and long-term. Effects on juvenile rearing habitat in the mainstem below Bonneville and the estuary would be similar to those described for SR fall chinook salmon, but could be more significant because the smaller chum smolts have a greater reliance on estuarine rearing. The proposed action is not expected to have an adverse effect on adult passage survival. However, the proposed action would reduce the availability of mainstem spawning habitat below Bonneville Dam by a low amount, because fall and winter flows are lower in the proposed action than in the reference operation (although flows generally remain above the 125 kcfs target). In summary, the quantitative and qualitative effect of the proposed action on the entire CR chum salmon ESU would be negligible.

***Number of MPGs:*** The presence of only three major population groups in this ESU (Section 4) means that it is likely that the viability of each population group is significant for this ESU's survival and recovery.

***Proportion of MPGs Reduced:*** All three major population groups would be negligibly affected by the proposed action.

***Range-wide Status of the ESU:*** As described in Section 4, this ESU is a threatened species. The BRT reported that, through 2001, long- and short-term productivity trends for ESU populations were at or below replacement. Abundance increased dramatically in 2002, but when 2003 preliminary returns are included, the 2001-2003 mean is lower than the 1996-2000 mean abundance. Even with this decline in mean abundance in 2003, preliminary analysis of the population trend indicates a stable population growth rate in 1990-2003. The BRT concluded that the natural component of the ESU had high risk for all of the VSP categories, particularly for ESU spatial structure and diversity. NMFS' June 14, 2004, Status Review and proposed listing determinations for salmon and steelhead indicated that recently initiated CR chum salmon artificial production programs provide slight benefits to ESU abundance and spatial structure, but have neutral or uncertain effects on ESU productivity and diversity. Collectively, hatchery programs do not substantially reduce the extinction risk of the ESU.

***Status of the ESU in the Action Area (Environmental Baseline):*** All of the fish in this ESU pass through part of the action area, and the status of the ESU in the action area is in large part the same as the range-wide status of the ESU described in Section 4. FCRPS flow management can limit the amount of, and access to, spawning habitat in the tailrace of Bonneville Dam. As described in Section 5, the existence and operation of the FCRPS has severely degraded habitat in the juvenile migration corridor, resulting in the current high levels of mortality for juvenile fish rearing in the lower river, estuary, and the ocean, as have other types of habitat loss. Improvements are expected under the FCRPS Action Agencies' 2004 UPA (Corps et al. 2004). However, the mainstem habitat-related biological requirements of juveniles are not being fully met within the action area.

***Cumulative Effects:*** CR chum salmon are affected by non-Federal water withdrawals within the action area. As described in Section 7.2, non-Federal water uses consume about 4 Maf each year between the upstream extent of the action area and Hells Canyon Dam, and some level of the effect of these flow depletions is propagated downstream into the portion of the action area occupied by this ESU.

***Summary:*** There is a mix of risk considerations for the CR chum salmon ESU, both range-wide and in the action area. If fish spawn upstream of Bonneville Dam, juvenile mortality in the environmental baseline, caused largely by the existence and operation of Bonneville Dam and other types of mainstem habitat loss, indicates low risk. Recent adult returns to mainstem spawning sites downstream from Bonneville Dam have varied, and short-term productivity trends for the ESU as a whole have declined, although they are still at replacement levels. This indicates some degree of ongoing range-wide risk, at least in the near-term. On average, over both the near and long-term, the effect of the proposed action would be to increase the survival of any subyearling migrants originating above Bonneville Dam by a negligible amount and to increase the availability of rearing habitat in the lower mainstem and estuary, but to reduce the availability of mainstem spawning habitat in the tailrace of Bonneville Dam. The proposed action is not expected to have an adverse effect on adult passage survival, and is likely to improve water quality conditions for juvenile spring migrants during high flow years by reducing the frequency and severity of elevated TDG conditions. Assuming that the range of future hydrologic conditions will be similar to that experienced over the past ten years, and the differences between the proposed action and the reference operation overestimate the potential survival effects of the proposed action (Section 5.2.2), and the negligible effect of the proposed action on the ESU as a whole, and considering the 4 Maf of ongoing consumptive non-Federal water withdrawals within the action area (Cumulative Effects), NMFS concludes that the proposed action is not likely to appreciably reduce the likelihood of survival and recovery of the CR chum salmon ESU.

### 8.13 SR Sockeye Salmon

After reviewing the current status of SR sockeye salmon, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects in the action area, it is

NMFS' opinion that the proposed action is not likely to jeopardize the continued existence of this species or adversely modify or destroy designated critical habitat.

***Magnitude of Reduction(s):*** There are no empirical data on passage survival for SR sockeye salmon, but the effects of the proposed action are expected to be similar to those estimated for SR spring/summer chinook salmon and SR steelhead, which also migrate in the spring as yearling fish. As described in Sections 8.2 and 8.7, this leads to the assumption that the proposed action would result in a very low to negligible reduction in juvenile survival compared to the reference operation. Effects on habitat are also assumed to be similar to those described for SR spring/summer chinook and SR steelhead: negligible differences in mainstem and estuarine habitats below Bonneville Dam and fewer involuntary spill events in high runoff years, benefiting both juvenile and adult migrants. In summary, the overall quantitative and qualitative effect of the proposed action on the entire SR sockeye salmon ESU would be negligible.

***Number of MPGs:*** There is only one extant population in this ESU (Section 4), so its viability is significant for this ESU's survival and recovery.

***Proportion of MPGs Reduced:*** The proposed action is not likely to reduce numbers, productivity, diversity, or the distribution of the single extant population in this ESU (Section 6).

***Range-wide Status of the ESU:*** As described in Section 4, this ESU is an endangered species. Only 16 naturally-produced adults have returned to Redfish Lake since the ESU was listed in 1991. The BRT found extremely high risk in all four VSP categories. NMFS' June 14, 2004, Status Review and proposed listing determinations for salmon and steelhead indicated that the SR sockeye salmon captive broodstock artificial production program has prevented extinction of the ESU, but has not mitigated the BRT's assessment of extreme risk in all four VSP categories.

***Status of the ESU in the Action Area (Environmental Baseline):*** All of the fish in this ESU pass through part of the action area, and the status of the ESU in the action area is in large part the same as the range-wide status of the ESU discussed in Section 4. Adult passage at existing dams is effective. As described in Section 5, the existence and operation of the mainstem FCRPS hydrosystem has severely degraded habitat in the juvenile migration corridor, resulting in high levels of mortality for juvenile fish migrating towards the ocean. Beginning in the 1980s, and especially in the last decade, structural and operational improvements at FCRPS projects have improved dam-passage survival for juvenile SR sockeye salmon migrating toward the ocean and additional improvements are expected under the FCRPS Action Agencies' UPA (Corps et al. 2004). However, the mainstem habitat-related biological requirements of juveniles currently are not being fully met within the action area.

***Cumulative Effects:*** SR sockeye salmon are affected by non-Federal water withdrawals within the action area. As described in Section 7.2, non-Federal water uses consume about 4 Maf each year between the upstream extent of the action area and Hells Canyon Dam, and the effect of these flow depletions is propagated downstream into the portion of the action area occupied by this ESU.

***Summary:*** There is a mix of high- and low-risk considerations for the SR sockeye salmon ESU, both range-wide and in the action area. High mortality in the environmental baseline, caused largely by the existence and operation of the FCRPS and other types of mainstem habitat loss, indicates relatively high risk. In recent years, adult returns and short-term productivity trends for the ESU have generally been increasing, but the population is still seriously depressed and the risk of extinction is very high. On average, over both the near and long-term, the proposed action is expected to reduce juvenile system survival by a very low to negligible amount compared to the reference operation. The proposed action is not expected to have any adverse effects on adult passage survival and is likely to improve water quality conditions for juvenile and adult spring migrants during high flow years by reducing the frequency and severity of elevated TDG conditions. Assuming that the range of future hydrologic conditions will be similar to that experienced over the past ten years, and the differences between the proposed action and the reference operation overestimate the potential survival effects of the proposed action (Section 5.2.2), and considering the negligible effect of the proposed action on the ESU as a whole, and considering the 4 Maf of ongoing consumptive non-Federal water withdrawals within the action area (Cumulative Effects), NMFS concludes that the proposed action is not likely to appreciably reduce the likelihood of survival and recovery of the SR sockeye salmon ESU.

***Critical Habitat:*** As described in Section 6.3.12.3, using the Environmental Baseline Approach, the proposed action would negatively impact the essential habitat features of water velocity and safe passage in the juvenile migration corridor. The reduction in water velocity is the main factor influencing safe passage through the migration corridor. The magnitude of the reduction in safe passage, compared to the reference operation, would be “low” to “medium” (i.e., an approximate 1% [based on SR spring/summer chinook salmon] to 3% [based on SR steelhead] lower in-river survival rate than under the reference operation) for the small proportion of the population that migrates entirely in-river past eight dams. For the ESU as a whole, the majority of which is barged around five to seven dams, there would be a negligible difference in survival between the two operations. For the reasons stated below, the reduction in flow would not appreciably diminish the value of designated critical habitat for this ESU as it relates to either its survival (because a relatively small proportion of the ESU is actually affected by it) or its recovery (because it would still be possible to operate the system to achieve the rate of safe passage possible under the environmental baseline into the future).

The status of safe passage and other essential features of critical habitat in the juvenile migration corridor habitat under the environmental baseline is poor. The juvenile migration corridor has been greatly modified by the existence of the FCRPS dams, reservoirs, and hydro system operations, as described in Section 5. A significant proportion of the migrating juveniles is transported around most FCRPS dams in order to avoid the baseline passage conditions. No actions that are properly considered cumulative effects are expected to change the status of critical habitat in the juvenile migration corridor. The range-wide status of the ESU is described above. It is characterized by a mixture of a long-term decline in abundance and productivity, short-term improvements in abundance and productivity over the past three to four years, and current abundance levels that are below interim recovery targets.

The question then becomes whether a small diminishment in the “safe passage” characteristic of the in-river critical habitat for SR sockeye salmon would constitute an appreciable reduction in the value of critical habitat for either survival or recovery of the ESU. In this case, because the in-river survival change indicative of safe passage only affects a relatively small proportion of the total juvenile migrants, given that most juvenile migrants are transported, NMFS concludes that the effect on the critical habitat, while negative, would not appreciably reduce the value of that habitat as it relates to the survival of this ESU.

When considering whether the alteration of safe passage by the proposed action appreciably diminishes the value of critical habitat for recovery, it is relevant to consider the future potential for critical habitat to meet the recovery needs of this ESU. Does the proposed action reduce the ability of the habitat under the environmental baseline to provide safe passage for this ESU in subsequent years? In this case, the reduction in safe passage is due to the operation that does not provide flow rates as great as those in the reference operation during the spring, in order to provide higher flow rates in the summer for the benefit of another species of listed fish (SR fall chinook salmon). The proposed operation, however, does not reduce the future availability of stored water in the spring, should the priority for release timing change in the future. Since this capacity of critical habitat to safely pass fish is not reduced, the proposed action does not appreciably diminish the value of the critical habitat for recovery.

After considering all of these factors, NMFS concludes that the proposed action would not be likely to adversely modify or destroy designated critical habitat for this ESU under the Environmental Baseline Approach.

Under the Listing Condition Approach applied in Section 6.3.12.3, there would be no adverse modification or destruction of critical habitat possible because there is not likely to be any alteration of essential features of critical habitat below their condition at the time this ESU was listed (i.e., 1992).

## 8.14 LCR Coho Salmon

After reviewing the current status of LCR coho salmon, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects in the action area, it is NMFS' opinion that the proposed action is not likely to jeopardize the continued existence of this species.

***Magnitude of Reduction(s):*** There are no empirical data on passage survival for LCR coho salmon, but the effects of the proposed action are expected to be similar to those estimated for spring-run populations in the LCR chinook salmon ESU, which also has yearling spring migrants. As described in Section 8.11, this leads to the assumption of that the proposed action would result in a negligible reduction in juvenile survival compared to the reference operation. Effects on habitat are also assumed to be similar to those described for spring-run LCR chinook salmon: negligible differences in mainstem and estuary habitats below Bonneville Dam and fewer involuntary spill events in high runoff years, benefiting both juvenile and adult migrants. In summary, the overall quantitative and qualitative effect of the proposed action on the entire LCR coho salmon ESU would be negligible.

***Number of MPGs:*** The presence of only three major population groups in this ESU (Section 4) means that it is likely that the viability of each population group is significant for this ESU's survival and recovery.

***Proportion of MPGs Reduced:*** The proposed action would not be likely to reduce the numbers, productivity, diversity, or the distribution of any of the four major population groups (Section 6).

***Range-wide Status of the ESU:*** As described in Section 4, this ESU has been proposed as a threatened species. The BRT reported that the two populations with appreciable natural productivity experienced increased returns in 2000 and 2001 but continue to have low abundance and productivity. The BRT concluded that the natural component of the ESU had extremely high risks in all VSP categories. NMFS' June 14, 2004, Status Review and proposed listing determinations for salmon and steelhead indicated that LCR coho salmon artificial production programs reduce risks to ESU abundance and spatial structure, pose risks to ESU diversity, and have uncertain effects on ESU productivity. Overall, hatchery programs collectively mitigate the immediacy of ESU extinction but do not substantially reduce the extinction risk of the ESU in-total in the foreseeable future.

***Status of the ESU in the Action Area (Environmental Baseline):*** All of the fish in this ESU pass through part of the action area. Adult passage is effective for the one major population group that originates above Bonneville Dam. As described in Section 5, the existence and operation of the FCRPS hydrosystem and other types of habitat loss have severely degraded the migration corridor such that the habitat-related biological requirements of juveniles are not being fully met in the action area.

***Cumulative Effects:*** LCR coho salmon are affected by non-Federal water withdrawals within the action area. As described in Section 7.2, non-Federal water uses consume about 4 Maf each year between the upstream extent of the action area and Hells Canyon Dam, and some level of the effect of these flow depletions is propagated downstream into the portion of the action area occupied by this ESU.

***Summary:*** There is a mix of risk considerations for the LCR coho salmon ESU, both range-wide and in the action area. Juvenile mortality in the environmental baseline, caused in part by the existence and operation of Bonneville Dam and other types of mainstem habitat loss, indicates relatively low risk. However, recent adult returns and short-term productivity trends for the ESU as a whole have increased and are at or above replacement levels, indicating reduced range-wide risk, at least in the near-term. As described above for spring-run LCR chinook salmon (Section 8.6), which also produce spring yearling migrants, over both the near and long-term, the proposed action is expected to negligibly reduce the survival of juvenile migrants from the two populations originating above Bonneville Dam. The proposed action is not expected to have an adverse effect on adult passage survival. Assuming that the range of future hydrologic conditions will be similar to that experienced over the past ten years, and the differences between the proposed action and the reference operation overestimate the potential survival effects of the proposed action (Section 5.2.2), and the negligible effect of the proposed action on the ESU as a whole, and considering the 4 Maf of ongoing consumptive non-Federal water withdrawals within the action area (Cumulative Effects), NMFS concludes that the proposed action is not likely to appreciably reduce the likelihood of survival and recovery of the LCR coho salmon ESU.

# 9. CONSERVATION RECOMMENDATIONS

## 9.1 Introduction

This section discusses NMFS' obligation to develop conservation recommendations under Section 7(a)(1) of the ESA, which states in part:

> All other Federal agencies shall, in consultation with and with the assistance of the Secretary, utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species listed pursuant to section 4 of this Act.

The following conservation recommendations were developed for this Opinion.

## 9.2 Water Quality

NMFS recommends that the USBR, in coordination with IDEQ and ODEQ, as part of the TMDL implementation planning process:

- As appropriate, work with State agencies and Tribes, as well as irrigation districts, canal companies, drainage districts, designated management agencies, and other interested entities, within the framework of Watershed Advisory Groups, Watershed Councils, and other appropriate public forums in Idaho and Oregon to develop plans for implementing the Snake River-Hells Canyon TMDLs and tributary basin load allocations. NMFS recommends that the USBR keep NMFS and Tribes informed about USBR's assistance efforts by providing annual reports.

- Provide technical assistance to irrigation system operators and other appropriate entities in implementing nutrient, sediment, and/or temperature improvement measures to help meet the States' TMDL load allocations, as identified in TMDL implementation plans, and as authorities and funding permit. NMFS recommends that the USBR keep NMFS informed about USBR's assistance efforts by providing annual reports.

- Develop and implement a basin-wide temperature monitoring plan for the upper Snake River to describe temperature regimes and dynamics relative to USBR's water management activities, including storage, diversions and return flows, and hydropower operations. NMFS recommends that the USBR keep NMFS and Tribes informed about USBR's temperature monitoring efforts and results by providing annual reports.

# 10. INCIDENTAL TAKE STATEMENT

## 10.1 Introduction

Section 9 of the ESA and Federal regulations pursuant to Section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct." Incidental take is defined as "take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity." Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the ESA, provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

NMFS has identified a reasonable and prudent measure to further minimize the impact of the incidental take authorized by this Opinion.

## 10.2 Amount or Extent of Anticipated Take

As discussed in greater detail in Section 6 above, NMFS has determined that the USBR's proposed action will have adverse effects on certain listed salmonids that occupy the mainstem Snake and Columbia Rivers below Hells Canyon Dam through significant habitat modifications that are reasonably certain to injure such fish. NMFS now further finds that incidental take of 10 listed and 1 proposed salmonid species is reasonably certain to result from the USBR's proposed action described in this Opinion. As described in Section 6 and summarized in Section 8, NMFS has determined that the USBR's proposed action will result in very low (1% or less, on average) to negligible (close to zero) mortality for these ESUs. This low level of incidental take is not feasible to monitor quantitatively, but the extent of take can be described as that which occurs under and is attributable to the USBR's proposed operations within the occupied portion of the action area (below Hells Canyon Dam) in all months of the year. No incidental take is expected for UWR chinook salmon or UWR steelhead.

## 10.3 Effect of the Take

In Section 8, NMFS determined that the projected levels of juvenile and adult survival through the FCRPS are not likely to jeopardize the continued existence of any of the 12 listed and 1 proposed species.

## 10.4 Reasonable and Prudent Measure

The actions proposed by the USBR minimize incidental take of 10 listed and 1 proposed salmonid species to the extent necessary and appropriate. The following monitoring and reporting requirements are required to ensure that the USBR implements the proposed actions as described in its BA and as considered in this Opinion.

### 10.4.1 New Contracts for Water Stored in USBR Projects

Because the USBR's salmon flow augmentation program is heavily dependent on annual water rentals from Idaho's water rental pools, which is a variable and insecure source, the USBR must consult with NMFS whenever a new contract would reduce streamflows or reduce USBR's ability to meet salmon flow augmentation commitments, as described in its PA, or whenever USBR otherwise determines that listed salmon or steelhead species or critical habitat may be affected.

### 10.4.2 Annual Coordination of the Salmon Flow Augmentation Program

The USBR must continue to coordinate annually with the Technical Management Team (TMT) and Regional Forum when planning and implementing its annual salmon flow augmentation program.

### 10.4.3 Annual Progress Report

The USBR must prepare a Progress Report each year to document actions that it has taken to implement the salmon flow augmentation program.

## 10.5 Terms and Conditions

The measures described in this section are nondiscretionary and must be undertaken by the USBR, which has a continuing duty to regulate the activities covered by this Incidental Take Statement. If the USBR fails to assume and implement the terms and conditions of this Incidental Take Statement, the protective coverage of Section 7(o)(2) may lapse. Thus the USBR must comply with the following terms and conditions, which implement the reasonable and prudent measures described above.

### 10.5.1 New Contracts for Water Stored in USBR Projects

Prior to entering into any agreement to commit uncontracted storage space in any of its reservoirs covered by this Opinion to any use other than salmon flow augmentation, or enter into a new contract that would reduce streamflows or reduce USBR's ability to meet its salmon flow augmentation commitments, as described in its PA, or whenever USBR otherwise determines that listed salmon or steelhead species or critical habitat may be affected, the USBR shall consult with NMFS under Section 7(a)(2) of the ESA. Such consultations shall identify the amount of discretionary storage being sought or the amount of streamflow reduction, the current probability of such storage or streamflow being available for salmon flow augmentation, and any plan to replace the storage volume or streamflows currently available to salmon flow augmentation that would be lost as a result of the proposed commitment. NMFS' criterion in conducting such a review is to ensure that there either be an improvement or "zero net impact" on Snake River flows and on USBR's ability to provide up to 487 Kaf for salmon flow augmentation. Replacement supplies should have at least an equal probability of being available for salmon flow augmentation as the storage space or streamflows that are being committed.

### 10.5.2 Annual Coordination of the Salmon Flow Augmentation Program

The USBR must continue to coordinate annually with the TMT and Regional Forum when planning and implementing its annual salmon flow augmentation program. USBR must provide and update estimates of flow augmentation volume acquisitions and delivery as part of the annual FCRPS Water Management Plan and for discussion at TMT meetings. In emergency situations, USBR must work with NMFS and the TMT within established Regional Forum procedures to assess whether actions can be taken to improve migration conditions.

Developing an annual salmon flow augmentation program and sharing it with TMT as a component of the FCRPS Water Management Plan will ensure that regional coordination occurs. NMFS will review the USBR's salmon flow augmentation program each year and inform the USBR if its plan appears inconsistent with the action that was evaluated in this Opinion.

### 10.5.3 Annual Progress Report

The USBR must prepare a Progress Report by December 31 of each year to document actions that it has taken to implement its salmon flow augmentation program. In particular, the USBR shall document and report to NMFS the specific amounts and sources of water provided as part of each year's flow augmentation program, as well as its overall success at procuring up to 487,000 acre-feet of water for salmon flow augmentation during the fish passage season.

These annual Progress Reports will be useful for confirming assumptions applied in the analyses included in this biological opinion (Section 6). This information will also help NMFS evaluate whether new information reveals effects of the action that may affect listed or proposed species in a way that was not previously considered (Section 12).

The USBR shall then use this information to inform, and, if necessary, adjust accordingly, the next year's salmon flow augmentation program.

# 11. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

## 11.1 Background

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance essential fish habitat (EFH) for those species regulated under a Federal fisheries management plan. Pursuant to the MSA:

- Federal agencies must consult with NMFS on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2)).

- NMFS must provide conservation recommendations for any Federal or State action that would adversely affect EFH (§305(b)(4)(A)).

- Federal agencies must provide a detailed response in writing to NMFS within 30 days after receiving EFH conservation recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NMFS' EFH conservation recommendations, the Federal agency must explain its reasons for not following the recommendations (§305(b)(4)(B)).

- EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting this definition of EFH: waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 CFR 600.10). "Adverse effect" means any impact which reduces quality and/or quantity of EFH, and may include direct (e.g., contamination or physical disruption), indirect (e.g., loss of prey or reduction in species fecundity), site-specific, or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810).

- EFH consultation with NMFS is required regarding any Federal agency action that may adversely affect EFH, including actions that occur outside EFH, such as certain upstream and upslope activities.

The objectives of this EFH consultation are to determine whether the PA as described in the USBR's BA (USBR 2004) would adversely affect designated EFH and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH.

## 11.2 Identification of EFH

Pursuant to the MSA, the Pacific Fisheries Management Council has designated EFH for three species of Federally managed Pacific salmon: chinook salmon (*Oncorhynchus tshawytscha*); coho (*O. kisutch*); and Puget Sound pink salmon (*O. gorbuscha*) (PFMC 1999). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable manmade barriers (as identified by the PFMC 1999) and longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for several hundred years). In estuarine and marine areas, designated salmon EFH extends from the nearshore and tidal submerged environments within state territorial waters out to the full extent of the exclusive economic zone offshore of Washington, Oregon, and California north of Point Conception to the Canadian border. Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999). Assessment of potential adverse effects to these species' EFH from the PA is based, in part, on this information. For purposes of this analysis, this Opinion addresses potential effects to chinook and coho salmon.

Designated EFH for groundfish and coastal pelagic species encompasses all waters from the mean high water line, and upriver extent of saltwater intrusion in river mouths, along the coasts of Washington, Oregon, and California, and seaward to the boundary of the U.S. exclusive economic zone (PFMC 1998a, 1998b). Detailed descriptions and identifications of non-salmonid EFH are contained in the fishery management plans for groundfish (PFMC 1998) and coastal pelagic species (PFMC 1998a). Casillas et al. (1998b) provide additional detail on the groundfish EFH habitat complexes. NMFS has identified seven groundfish habitat complexes (estuarine, rocky shelf, non-rocky shelf, neritic zone, oceanic zone, continental slope/break and canyon) and identified species that may occur in each of those areas. The estuarine complex, which (with the neritic zone) is pertinent to this consultation, includes those waters, substrates and associated biological communities within bays and estuaries of the EEZ, from mean higher high water level (MHHW) or extent of upriver saltwater intrusion to the respective outer boundaries for each bay or estuary, as defined in 33 CFR 80.1 (Coast Guard lines of demarcation). The neritic zone is the relatively shallow ocean that extends from the outer edge of the intertidal zone to the edge of the continental shelf. It therefore contains the Columbia River plume. Two groundfish, two coastal pelagic, and two salmon species (chinook and coho) are included in the action area for the PA (Table 11-1).

**Table 11-1.** Non-salmonid fish species with EFH in the action area for operations and maintenance of the USBR projects in the Snake River basin above Brownlee Reservoir.

| Species | Habitat Preferences |
|---|---|
| Starry Flounder<br>*Platichthys stellatus* | mud, sand; often found in estuaries and upstream in freshwater |
| English sole<br>*Pleuronectes vetulus* | sand, mud |
| Northern Anchovy<br>*Engraulis mordax* | pelagic |
| Pacific Sardine<br>*Sardinops sagax* | pelagic |

Source:
Casillas, E., L. Crockett, Y. deReynier, J. Glock, M. Helvey, B. Meyer, C. Schmitt, M. Yoklavich, A. Bailey, B. Chao, B. Johnson, and T. Pepperell, 1998. Essential Fish Habitat West Coast Groundfish Appendix. Seattle, Washington, National Marine Fisheries Service: 778 pp.
Emmett, R. L., S. L. Stone, et al. (1991). Distribution and abundance of fishes and invertebrates in west coast estuaries, Volume II: Species life history summaries. Rockville, MD, NOAA/NOS Strategic Environmental Assessments Division**:** 329.

## 11.3 Proposed Action

For this EFH consultation, the PA and action area are described in the USBR's November 2004 PA and in Section 5 of this Opinion, respectively. The action area is in portions of the states of Oregon, Washington, and Idaho that are also within the range of EFH designated under the MSA. The action area relative to both juvenile and anadromous salmonids is that part of their in-water and riparian habitat that would be affected by the proposed operations and maintenance of the USBR's projects above Brownlee Reservoir that are described in the PA. Parts of the action area below Hells Canyon Dam serve as a migratory corridor for juveniles and adults of five ESA-listed species of chinook salmon (SR spring/summer and fall chinook salmon, UCR spring chinook salmon, UWR chinook salmon, and LCR chinook salmon) and one species of coho salmon (LCR coho salmon), which is proposed for listing. All six of these species are considered in this Opinion. The area serves to a varying extent as habitat for spawning, rearing, and growth and development to adulthood for these salmonids. EFH is also designated in the action area for three unlisted species of chinook salmon: Deschutes River summer/fall-run, MCR spring-run, and UCR summer/fall-run chinook salmon ESUs. The PA includes the effects of flow on EFH in areas of the Columbia River estuary and plume used by two species of groundfish, starry flounder, and English sole, and two coastal pelagic species, northern anchovy and Pacific sardine, for which EFH is also designated.

## 11.4 Effects of Proposed Action

As described in Section 6 of this Opinion, the proposed operations and maintenance of the USBR's projects above Brownlee Reservoir may result in short- and long-term impacts, both positive and negative, to a variety of habitat parameters. The adverse impacts to EFH for the unlisted chinook and proposed coho salmon species are the same as those described for the ESA-listed salmonids. Therefore, the ESA effects analysis in this Opinion addresses impacts of the PA to salmon EFH. As described in the following sections, the proposed operations and maintenance of the USBR's projects above Brownlee Reservoir are likely to negatively affect some properties of designated EFH.

### 11.4.1 Effects on Mainstem Habitat Conditions, Including the Estuary and Plume

#### 11.4.1.1 Effects of Flow Management on EFH

**11.4.1.1.1 Effects of Flow Management on EFH for Salmonids**. Compared to the reference operation, the PA would cause a moderate net reduction (8.0%) in seasonal average spring flows in the Snake River when juvenile SR spring/summer chinook salmon migrate through that part of the action area (Section 6.2.1 and Table 6-3). In the lower Columbia River, the PA would reduce spring flows 2% to 5%, reducing the system survival of yearling migrant SR spring/summer chinook salmon, UCR spring chinook salmon, UWR chinook salmon, some populations of LCR chinook salmon, and (unlisted) MCR spring chinook salmon by negligible amounts (Section 6.3).

By affecting streamflows during the juvenile outmigration (April through August), the PA would affect water temperatures and related survival factors. Compared to the reference operation, the PA would negligibly reduce average monthly water temperatures in the lower Snake River during spring, a slight benefit for yearling migrants. Results for summer were mixed. Water temperature decreases in the months of May and June (Tables 6-2 and 6-3) would improve the survival of juvenile SR fall chinook salmon rearing in Lower Granite Reservoir; however, an increase in water temperatures in late June and July, when the majority of subyearling juveniles are actively migrating, would decrease survival through that reservoir.

Water temperatures would be slightly decreased at Ice Harbor Dam and unaffected by the PA at McNary Dam during the juvenile migration period. This suggests that the effect of the PA on temperature-related habitat conditions downstream from Lower Granite Dam for juvenile SR fall chinook salmon would show a small improvement under the PA compared to reference operation.

Temperature-related habitat conditions for migrating adult salmonids upstream from Lower Granite Dam would be slightly adversely affected by the PA. However, by October, when SR fall chinook salmon begin spawning, the PA would have no effect on flows, and thus no effect on water temperature or water temperature-related spawning habitat.

Two sets of authors recently evaluated the sensitivity of the amount and distribution of shallow-water rearing habitat in the lower Columbia River (i.e., Hyde et al. 2004, for conditions in RMs 0-35; Jay et al. 2004 for RMs 35-55) to changes in discharge at Bonneville Dam during July through September (Section 6.2.1.1). Snake River fall chinook, UCR summer/fall chinook, and Deschutes River summer/fall chinook salmon produce subyearling smolts that migrate through and rear within the mainstem during summer, as do migrants from fall-run populations of LCR chinook salmon. Hyde et al. (2004) focused on the sensitivity to changes in discharge in the 150 to 190 kcfs range, which brackets the USBR's PA and the reference operation. In the lower 35 miles of the Columbia River, changes in FCRPS hydro system operations that would result in discharges in the range of 150 to 190 kcfs would appear to have only slight impacts on the total area of shallow-water habitat available and the hours during which it would fit specific depth criteria. Hyde et al. (2004) suggested that this was because the length of time an area was inundated increased with flow and as a function of its interaction with the tide. The direction and strength of these impacts would vary within the lower estuary.

Due to extensive diking and the effects of tides, Jay et al. (2004) found that the amount of shallow-water habitat in the lower Columbia River varies very little over a much wider range of flow changes than those identified as effects of the USBR's PA. Thus, effects on juvenile rearing habitats are likely to be small to negligible.

The reduction of the spring freshet associated with the PA may have a somewhat larger influence on habitat conditions in the Columbia River plume. Assuming that effects on the habitat value of the plume roughly equal the relative change in spring discharge, the PA would reduce the plume's habitat value by about 3%. As stated in Section 5, the plume's role as salmon and steelhead habitat is poorly understood. However, a 3% reduction in the size of the plume would appear to be a relatively small effect.

**11.4.1.1.2 Effects of Flow Management on EFH for Groundfish**. Two groundfish species, the starry flounder and the English sole, are likely to have designated EFH in areas affected by the PA. Starry flounder spawn in the ocean, and juveniles enter the estuary at a young age where they are associated with the bottom, feeding on amphipods and copepods (Fox et al. 1984). They are distributed throughout the estuary, but younger fish (less than 2 years) are more concentrated in the freshwater or low salinity areas. Fish older than 2 years are more concentrated in areas of higher salinity. During spring, abundance is generally low and flounder are restricted to part of Youngs Bay and an area between Tongue Point and Woody Island (approximately RM 29). During summer and fall, they are more widely distributed but are most abundant in areas of low velocity currents such as Grays Bay, Youngs Bay, Baker Bay, Cathlamet Bay, and intertidal habitats, where their principal prey, amphipods, concentrate.

The English sole is a marine species that is associated with the bottom for most of its life cycle. It prefers high salinities and therefore is found only in the downriver portions of the estuary where the population, primarily juveniles, feed and rear (Fox et al. 1984). English sole eat mainly copepods, amphipods, and mysids, but also incorporate the clam *Macoma balthica*, polychaetes, and oligochaetes into their diet. Sole less than 1 year old are localized in low-velocity, shallow areas such as the Ilwaco and Chinook Channels during spring, but are distributed further upriver in relatively saline water during summer and fall. Both their relative abundance and distribution in the estuary decrease in winter. Relatively few of the individuals in the estuary are 1 year old or older, and these are found downriver from the Astoria-Megler Bridge year round.

Both species are associated with low-velocity, shallow-water habitat in the estuary, where their prey are abundant. Thus, effects on estuarine EFH are likely to be similar to those described in Section 11.4.1.1.1 for subyearling salmon. That is, there is only a slight difference between the PA and reference operation in the total area of shallow-water rearing habitat available in the lower Columbia River and the hours during which it fits specific depth criteria, with the difference greatest during summer and in the upstream tidally influenced reach closest to Bonneville Dam.

**11.4.1.1.3 Effects of Flow Management on EFH for Coastal Pelagic Species**. Northern anchovy are distributed from the Queen Charlotte Islands, British Columbia, to Magdalena Bay, Baja California, and anchovy have recently colonized the Gulf of California (PFMC 1998c). The population is divided into northern, central, and southern subpopulations, or stocks. The southern subpopulation is entirely within Mexican waters. The central subpopulation, which supports significant commercial fisheries in the U.S. and Mexico, ranges from approximately San Francisco, California, to Punta Baja, Baja California. The bulk of the central subpopulation is located in the Southern California Bight, a 20,000-square-nautical-mile area bounded by Point Conception, California, in the north and Point Descanso, Mexico (about 40 miles south of the U.S.-Mexico border) in the south. The geographic distribution of northern anchovy has been more consistent over time and is more nearshore than the geographic distribution of Pacific sardine.

The northern anchovy is commonly found both within the Columbia River estuary and offshore in large schools during all seasons. Adults spawn in the ocean, but all life stages can be found in the estuary where they feed mostly on copepods (and some phytoplankton) in the water column (Fox et al. 1984). Fish older than one year prefer higher salinity areas and are found further upriver when outflow is lower.

It is generally accepted that sardine off the west coast of North America form three subpopulations or stocks: a northern subpopulation (northern Baja California to Alaska), a southern subpopulation (off Baja California), and a Gulf of California subpopulation. A fourth, far northern subpopulation has also been postulated (PFMC 1998c). Although the ranges of the northern and southern subpopulations overlap, the stocks may move north and south at similar times and not overlap significantly.

Pacific sardines are pelagic at all life history stages. They occur in estuaries, but are most common in the nearshore and offshore domains along the coast. They have been captured in both purse and beach seines in the Columbia River estuary, often with anchovies. Like the northern anchovy, sardines are planktivorous, consuming both phytoplankton and zooplankton.

The difference between flows in the lower Columbia River under the proposed and reference operations would be slight, but larger during summer and in the upstream tidally influenced reach closest to Bonneville Dam. For pelagic species, the increase in summer flows means that the aerial extent of the low salinity environment in the plume will also be slightly larger. There is no information available on how habitat use by coastal pelagic species is affected by changes in flow on the order of the difference between the reference operation and the PA.

### 11.4.1.2 Effects of Spill Operations on EFH for Salmonids

The PA would have very small negative effects on voluntary spill levels in some years by decreasing total river flows (Section 6.3). Voluntary spill provides a non-turbine avenue for dam passage, reducing turbine-induced mortality and injury and reducing dam passage delay. Reductions in voluntary spill would occur primarily in average and low flow years and primarily at FCRPS projects for which the established spill criteria area a percentage of total project discharge (e.g., Lower Monumental, John Day, and The Dalles Dams).

More significantly, by storing water during the spring freshet, the PA would reduce the likelihood of high spill events that generate adverse levels of TDG at various projects in the migratory corridor. HYDSIM modeling results show that involuntary spill events would mostly occur in April, May, and June, with rare spill events in March and July (Table 6-3). These months cover the peak of the spring migration for SR spring/summer chinook salmon, UCR spring chinook salmon, some populations of LCR chinook salmon, UWR chinook salmon, and LCR coho salmon, and the period of SR fall chinook salmon rearing in the mainstem corridor.

## 11.5 Conclusion

NMFS concludes that the USBR's PA would adversely affect EFH for Columbia Basin chinook and coho salmon.

## 11.6 EFH Conservation Recommendations

Pursuant to §305(b)(4)(A) of the MSA, NMFS is required to provide EFH conservation recommendations to Federal agencies, including itself, regarding actions that would adversely affect EFH. NMFS believes that the following three conservation measures, which are identical to the terms and conditions stated in the USBR's Incidental Take Statement (Section 10), are needed to avoid, mitigate, or offset the effect that the PA would have on designated EFH for chinook and coho salmon. Consequently, NMFS recommends that the USBR adopt the terms and conditions in Section 10 of this Opinion as EFH conservation measures.

### 11.6.1 New Contracts for Water Stored in USBR Projects

Prior to entering into any agreement to commit uncontracted storage space in any of its reservoirs covered by this Opinion to any use other than salmon flow augmentation, or enter into a new contract that would reduce streamflows or reduce USBR's ability to meet its salmon flow augmentation commitments, as described in its PA, or whenever USBR otherwise determines that listed salmon or steelhead species or critical habitat may be affected, the USBR shall consult with NMFS under Section 7(a)(2) of the ESA. Such consultations shall identify the amount of discretionary storage being sought or the amount of streamflow reduction, the current probability of such storage or streamflow being available for salmon flow augmentation, and any plan to replace the storage volume or streamflows currently available to salmon flow augmentation that would be lost as a result of the proposed commitment. NMFS' criterion in conducting such a review is to ensure that there either be an improvement or "zero net impact" on Snake River flows and on USBR's ability to provide up to 487 Kaf for salmon flow augmentation. Replacement supplies should have at least an equal probability of being available for salmon flow augmentation as the storage space or streamflows that are being committed.

### 11.6.2 Annual Coordination of the Salmon Flow Augmentation Program

The USBR should continue to coordinate annually with the TMT and Regional Forum when planning and implementing its annual salmon flow augmentation program. USBR must provide and update estimates of flow augmentation volume acquisitions and delivery as part of the annual FCRPS Water Management Plan for discussion at TMT meetings. In emergency situations, USBR should work with NMFS and the TMT within established Regional Forum procedures to assess whether actions can be taken to improve migration conditions.

Developing an annual salmon flow augmentation program and sharing it with the TMT as a component of the FCRPS Water Management Plan will ensure that regional coordination occurs. NMFS will review the USBR's salmon flow augmentation program each year and inform the USBR if its plan appears inconsistent with the action that was evaluated in this Opinion.

### 11.6.3 Annual Progress Report

The USBR must prepare a Progress Report by December 31 of each year to document actions that it has taken to implement its salmon flow augmentation program. In particular, the USBR shall document and report to NMFS the specific amounts and sources of water provided as part of each year's flow augmentation program, as well as its overall success at procuring up to 487,000 acre-feet of water for salmon flow augmentation during the fish passage season.

These annual Progress Reports will be useful for confirming assumptions applied in the analyses included in this biological opinion (Section 6). This information will also help NMFS evaluate whether new information reveals effects of the action that may affect listed or proposed species in a way that was not previously considered (Section 12).

The USBR shall then use this information to inform, and, if necessary, adjust accordingly, the next year's salmon flow augmentation program.

## 11.7 Statutory Response Requirement

Pursuant to the MSA (§305(b)(4)(B)) and 50 CFR 600.920(j), Federal agencies are required to provide a detailed written response to NMFS' EFH conservation recommendations within 30 days of receipt of these recommendations. In case of a response that is inconsistent with the EFH conservation recommendations, the response must explain the reasons for not following the recommendations, including the scientific justification for any disagreements over the anticipated effects of the PA and the measures needed to avoid, minimize, mitigate, or offset such effects.

## 11.8 Supplemental Consultation

The Action Agencies must reinitiate EFH consultation with NMFS if the PA is substantially revised in a manner that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations (50 CFR 600.920(k)).

# 12. REINITIATION OF CONSULTATION

## 12.1 General Considerations

Consultation must be reinitiated if the amount or extent of taking specified in the incidental take statement is exceeded, or is expected to be exceeded; if new information reveals effects of the action that may affect listed species in a way not previously considered; if the action is modified in a way that causes an effect on listed species that was not previously considered; or if a new species is listed or critical habitat is designated that may be affected by the action (50 CFR 402.16).

To the extent that prospective agreements or contracts are used to achieve operations that are in accordance with this Opinion, including its terms and conditions, the effects of those prospective agreements or contracts on listed fish have been considered in this Opinion. To the extent that proposed agreements or contracts impact USBR operations that affect listed fish in ways not considered in this Opinion, or have provisions that go beyond implementing the operations specified in the Opinion, those proposed actions may require separate consultation or reinitiation of this consultation.

## 12.2 Annual Evaluations

In addition to the general conditions described above, the USBR will provide NMFS with an annual report that describes its success in delivering up to 487,000 acre-feet from its Upper Snake Basin projects. If the USBR is unable to provide water for Snake River flow augmentation in amounts and frequencies assumed in the development of the PA, NMFS will evaluate whether to recommend supplemental consultation or reinitiation of this consultation. Factors considered by NMFS in this decision include: 1) evaluating whether the USBR Salmon Flow Augmentation Program has adequately delivered the volumes of flow augmentation water at the frequencies considered in this consultation and identified in its November 2004 BA; 2) the significance of not providing the full 487,000 acre-feet or other volumes of salmon flow augmentation at the frequencies considered in this consultation and identified in its November 2004 BA; and 3) any effects on the regulatory reasons for reinitiation of consultation (see above).

## 12.3 Duration of the Proposed Action

The duration of the USBR's proposed actions, and therefore this biological opinion, is explicitly conditioned by the USBR-NMFS understanding referenced in section 2.2 of the 2004 USBR BA, which states that it may be necessary, after 2010, to reinitiate this consultation depending upon the status of actions to address needed water temperature improvements in the mainstem Snake River in reaches occupied by listed anadromous fish species above the reservoir pool created by the Corps' Lower Granite Dam. Such water temperature improvement actions are expected by NMFS to be resolved in discussions which will occur outside of the scope of the SRBA and the implementation of the Term Sheet (USBR 2004).

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